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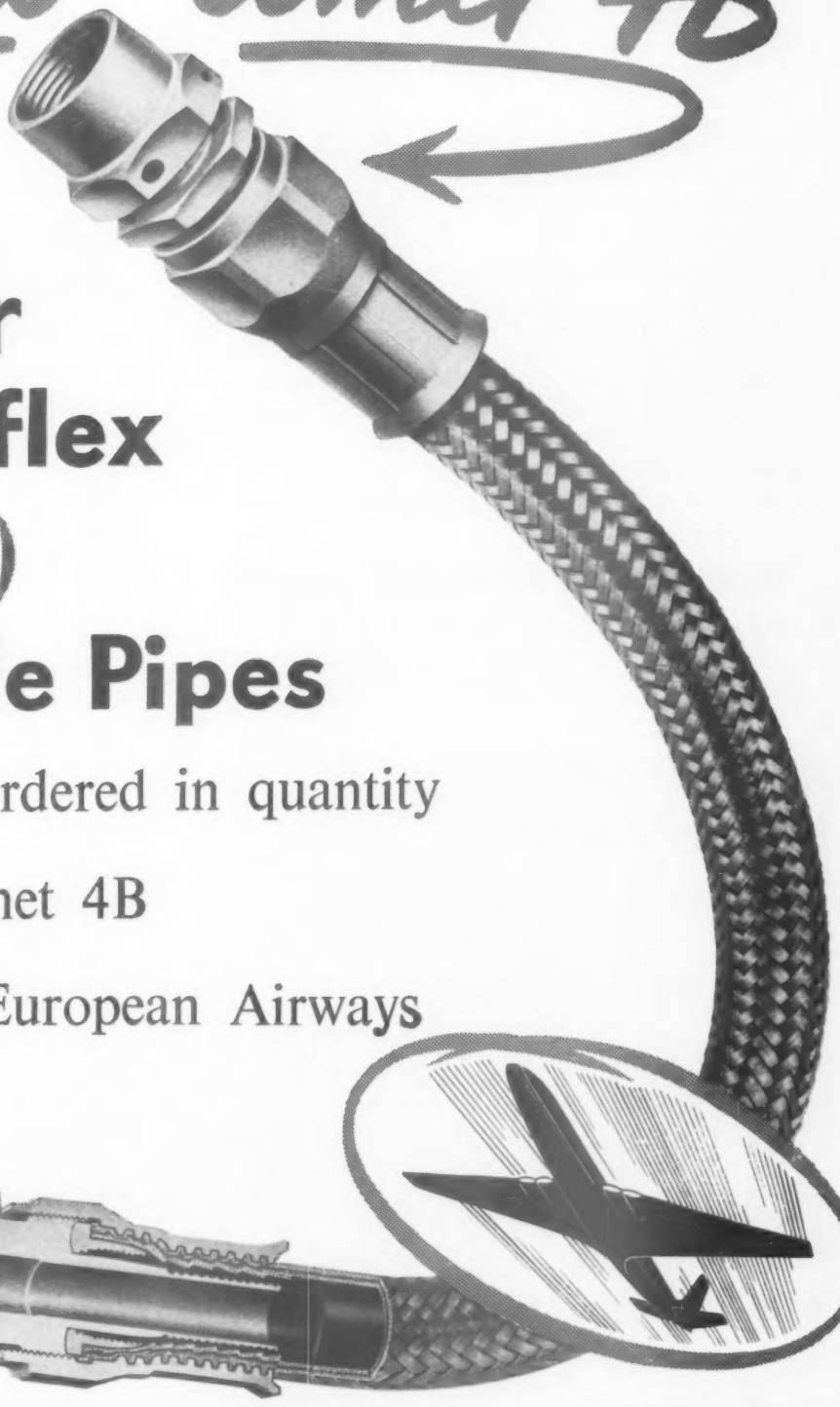

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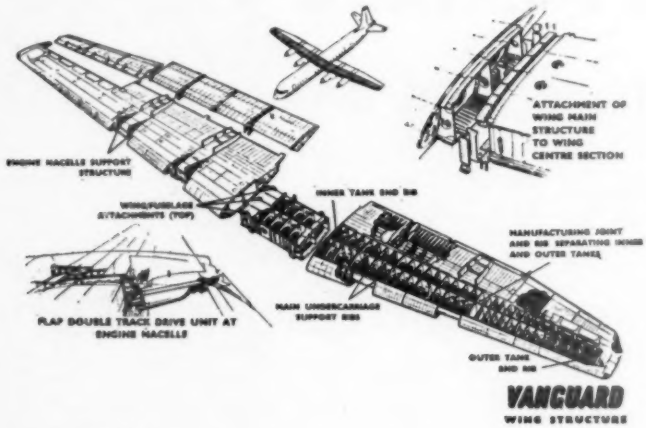
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OUTER TANK END RIB

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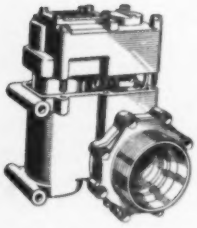

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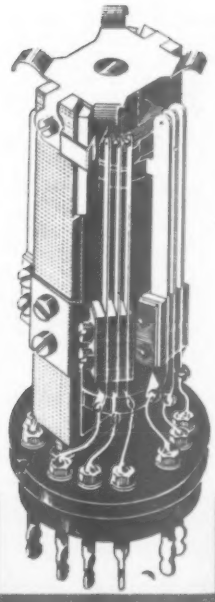

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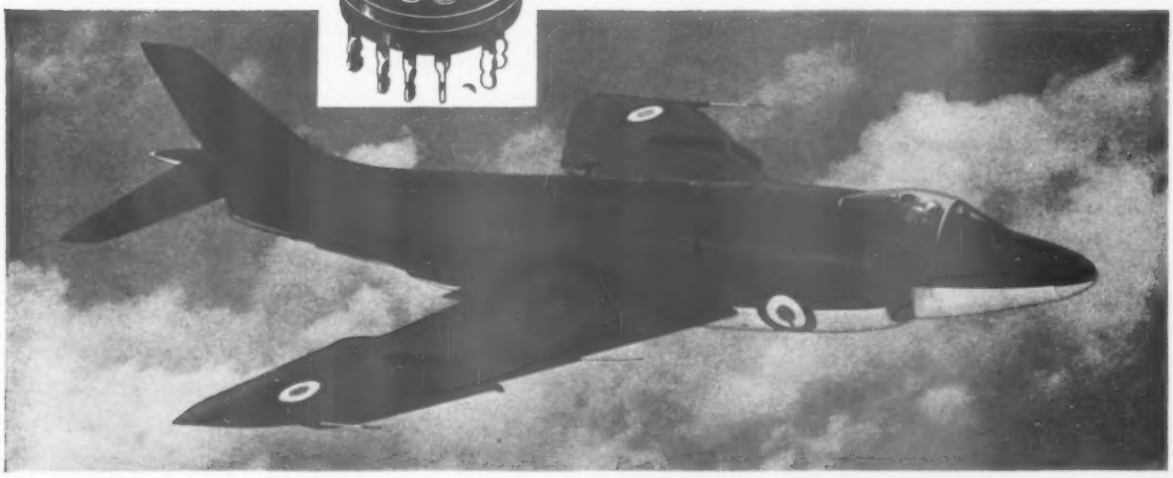

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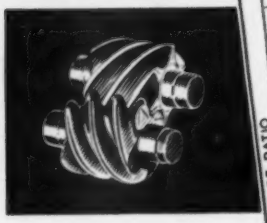

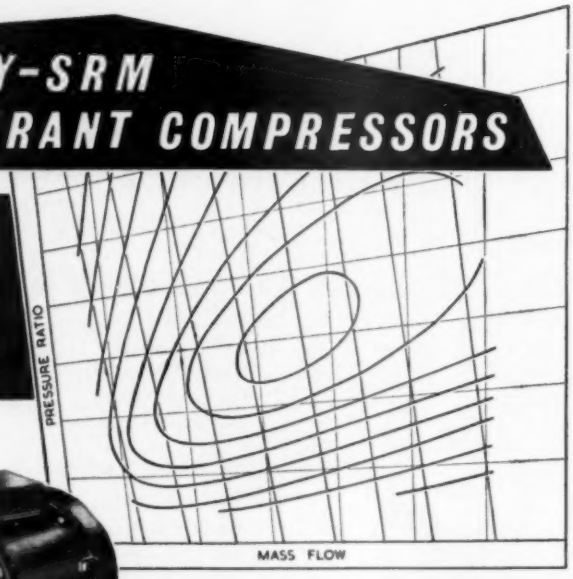

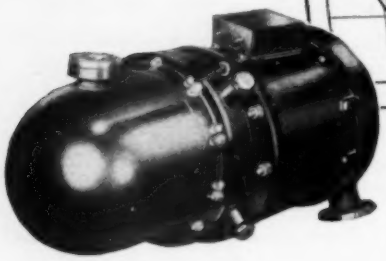

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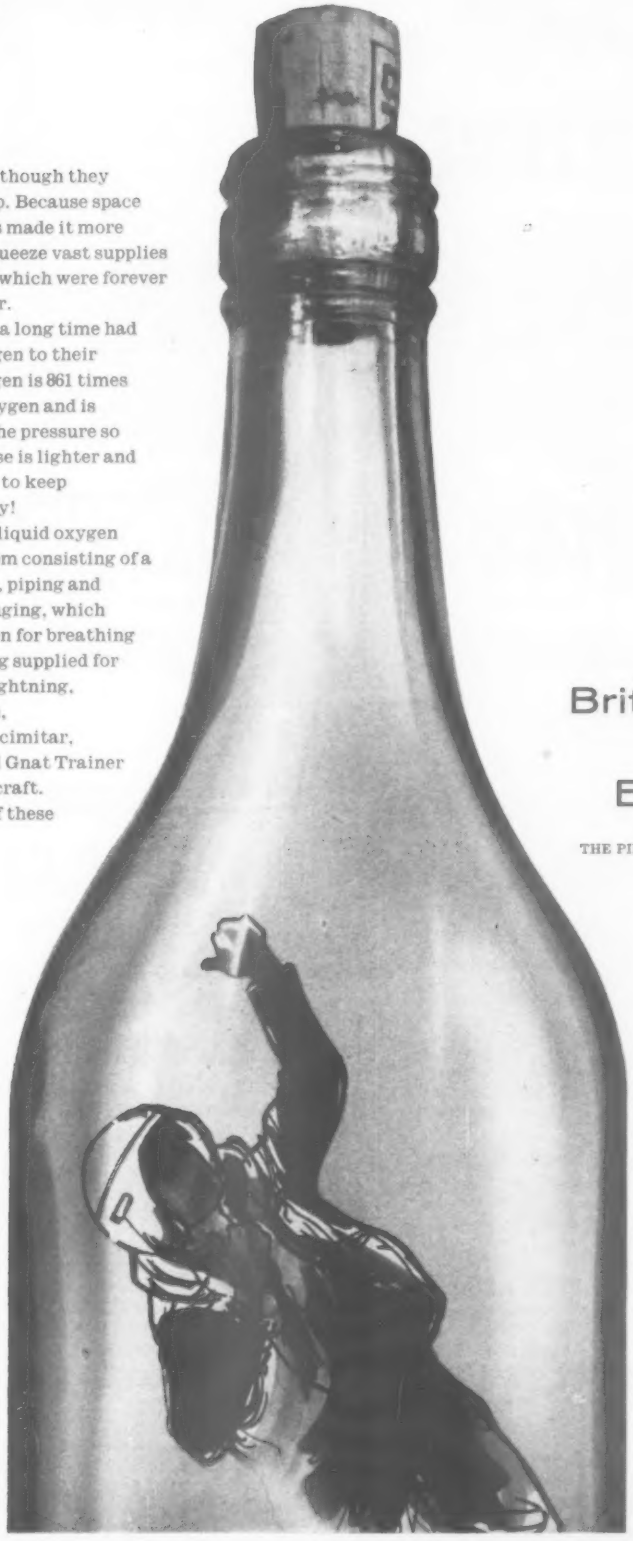

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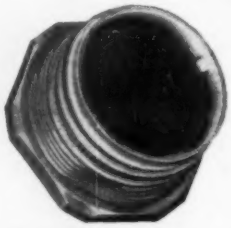

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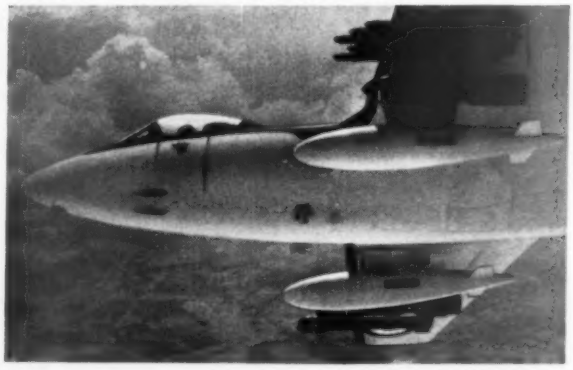

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THE AEROPLANE

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PROBLEMS OF THE MECHANICAL PILOT

AT dinner recently some guests just back from a visit to places well east of Suez told of an unnerving incident when they watched the wing of the brand-new aeroplane in which they were travelling start to move down slowly towards the ground from which they had just taken off. The motion was steady and continued for so long that the experienced air travellers who were telling the story began to think there could be no recovery. Fortunately there was, otherwise this story would not have been retailed first hand, and slowly turning back onto course, the aeroplane continued its climb. Much later it came out that the incident was due to action taken by a pilot under instruction to avoid flying into a flock of vultures. Experience in those parts has been such that pilots feel happier manœuvring the aeroplane pretty abruptly rather than risk a collision with a large bird or birds. Only last week a tragedy was reported from an African game park where a naturalist flying a light aeroplane had crashed after hitting a vulture in the air; there seemed to be some suggestion in this instance that the bird had attacked the aeroplane. Collision with birds is no new air hazard, though it still persists as a danger and in some ways the increasing size and speed of civil aircraft has not improved matters. Much work, for instance, has been done to strengthen windscreens against shattering should they be struck by a bird.

The talk these days is all of making the control of the aircraft more and more automatic. Some progress has been made towards the completely automatic landing and the more progress that is made in this direction the heavier the burden of responsibility that is thrown upon those responsible for the design and manufacture of the automatic pilot and its associated equipment.

It is a far cry since "George" first appeared on the scene. Indeed it is so long that the automatic pilot has lost much of its individuality and its pet name is seldom heard. Yet there is not an airliner flying on a scheduled air route in which the bulk of the flying is not done through the medium of the complex of gyroscopes and associated gear which forms the automatic pilot. The complexity of this mechanism has been further extended by the increasing adoption of power-operated controls with the associated need of artificial "feel." We have come a long way from the days when the pilot's own physical effort had to be steadily employed throughout a long and tiring flight to maintain the aircraft on a correct and steadily flown course.

We have too many reminders of the dangers that surround the operation of aircraft; accidents on take-off and on landing; accidents that can arise when a pilot is forced to land off course. And such hazards increase with speed. On the other hand with increasing speed has come the increasing complexity of the automatic controls to which we have referred. It is a remarkable thing how rarely one hears of any serious malfunctioning. In places where pilots exchange experiences one will hear of occasions when an automatic pilot "ran away" but so smoothly do they function normally that most passengers would be surprised to learn for how much of any given trip they had been flown by a mechanical pilot. This in itself is a measure of the reliability which has been achieved.

From time to time incidents occur in which some part of the control gear malfunctions with results that are disconcerting and inherently dangerous. A spectacular example was the incident that befell the Boeing 707 on its Atlantic crossing on a journey from Paris to New York, as we briefly reported last week. It seems that as a result of some trouble in the automatic control the aeroplane went into a very steep spiral dive with a consequent increase in speed. Whether attempts were first made to correct the dive without easing the power we do not know, but it has not been denied that a speed was reached in excess of the permissible Mach number and that in consequence there was considerable buffeting. It must have been a most unpleasant experience for the large number of passengers on board, as well as for the crew. As we have said, there have been previous incidents of a similar nature, but never before to such a large and fast aeroplane.

The question that will be asked and, therefore, the one that will require answering, is how is a repetition to be avoided. And this is a question which is of special interest to us in this country, for not only are B.O.A.C. to have Boeing 707s but, as we have recently reported, the VC-10 is to have similar automatic gear from the United States. It must not be thought that such incidents can arise because insufficient thought has been given to the incorporation of safeguards. Almost the reverse is true; the system as a whole is "fail-safe" so long as all the associated units are serviceable at the time of failure. Some modern types of autopilot have their performance monitored by a unit which obtains its reference data from separate sources. The question that needs to be answered is why the equipment did *not* fail safe in this particular case.

Matters of Moment

R.Ae.S. Expansion

AN innovation which met with general approval marked the annual presidential reception at the headquarters of the Royal Aeronautical Society at 4 Hamilton Place, London, W.1, on February 13. Hitherto for some years past the reception has been preceded by the presidential address. This year the occasion began with the reception; Sir Arnold and Lady Hall, with their daughter Caroline, greeting the guests in the anteroom of the library.

There were three buffets, though the throng was densest in the library. Here were to be found Sir Aubrey and Lady Burke and Sir George and Lady Gardner receiving the congratulations of friends on the honours awarded to them in the New Year list.

The innovation to which we have referred was the use of closed-circuit television. Equipment had been set up in each of the buffets; in the library, for instance, there were three screens and towards nine o'clock guests were invited to group themselves around them. Sir Arnold Hall then made his address. So far as the speech went the system worked from the start. Unfortunately, the screens took some while to come alive; when they did the results were excellent.

In the course of his talk Sir Arnold made some notable points about the work of the Society which now has a membership of over 10,000 and 28 branches. Playing a leading part in the advance of aeronautical knowledge are the Society's publications. The *Journal*, which has appeared without a break since 1893, has a world-wide distribution; some three thousand copies are distributed to a total of seventy-five countries. We were particularly interested to note that Australia took about two-thirds as much as that sent to North America which, considered in terms of relative populations, is most enlightening.

Sir Arnold enlivened his talk with the aid of charts and diagrams. These were particularly helpful in demonstrating the extent of the work done in preparing the R.Ae.S. Data Sheets by the Society's full-time technical staff.

At the close Sir Arnold told his audience about the promising progress now being made with the plans for a lecture theatre. As a result of the replanning of Hyde Park Corner, a practical possibility has arisen of erecting a lecture theatre adjacent to 4 Hamilton Place. This would indeed be a great thing ff the necessary planning permissions are forthcoming from the various authorities involved.

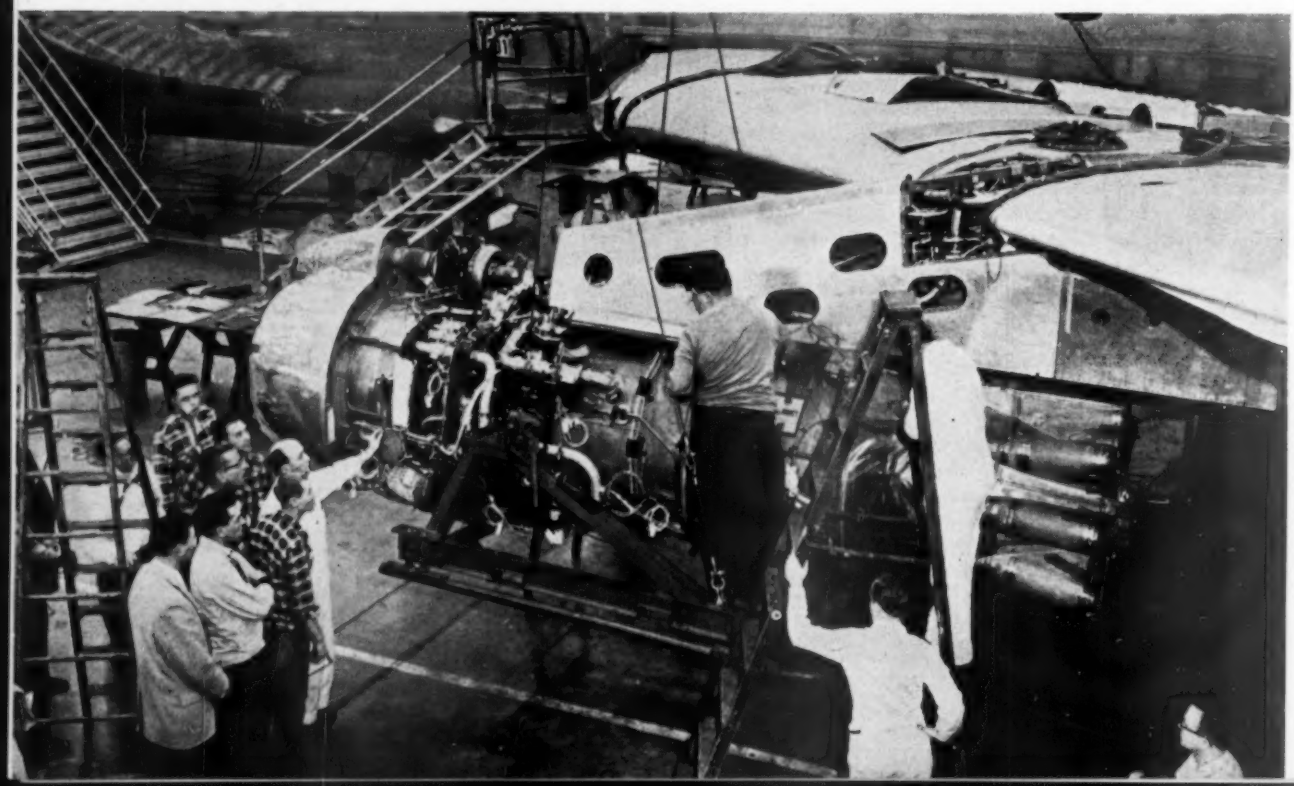
The President is hopeful of soon being able to say a great deal more. Now that the Society has over ten thousand members the question of raising the necessary sums should be much easier than a few years ago when the Society was half the size.

BOMBER A.O.C.-in-C.—Air Vice-Marshal K. B. B. Cross, who succeeds Air Chief Marshal Sir Harry Broadhurst as Air Officer Commanding-in-Chief, Royal Air Force, Bomber Command in May.

British Space Progress

ALTHOUGH Britain has no official space programme, British scientists are now working on practical problems of space technology. This was made clear by the exhibits and demonstrations which accompanied the lecture on Earth satellites given before the Royal Aeronautical Society on February 12 by

CONWAY INSTALLATION.—A recent event at Boeing's Seattle plant was the installation of the first Rolls-Royce Conway in the first of the 15 Boeing 707-420 Intercontinentals on order for B.O.A.C. Conways have also been selected as powerplants for the 707s being built for Lufthansa, Air-India International and Varig Airlines.



ELANDS OVER CANADA.—First air-to-air view of the Canadair-Convair 540, turboprop transport for the R.C.A.F., which made its initial flight recently; it is powered by two Napier Elands. An aircraft of this type is scheduled to make an extensive tour of Europe in May prior to visiting the Paris Aero Show in June.

MR. W. H. STEPHENS, director general of ballistic missiles at the Ministry of Supply. His lecture is reported on p. 226.

The most interesting of these exhibits showed methods of stabilizing a satellite; the exhibits were produced by the guided-weapons department of the R.A.E. One was a reaction-control set which used jets of catalytically decomposed HTP for the roll stabilization of a rocket test vehicle; this set had been successfully flown. Another was a 3,000-p.s.i. compressed-air bottle, incorporating air-supply valves, which will be used for three-axis air-jet stabilization of the separated instrument head of a Skylark rocket.

A demonstration model showed how the torque of small electric motors could be used to give fine attitude control of a satellite by conservation of angular momentum. Power for the motors could be supplied by solar batteries.

The lecture discussion centred on the need for a British space programme. Mr. Stephens said that the cost of scientific instrumentation need not be excessive if a satellite programme were based on military support. He was hopeful that scientific pressure for a space programme—which included the backing of the Royal Society—would prevail. He felt that while international co-operation was excellent for planning research programmes with satellites and for analysing the results, the actual production of hardware was best left to a single designer if progress was to be made fast enough.

PROF. A. D. BAXTER of de Havilland Engines and MR. A. V. CLEAVER of Rolls-Royce both advocated the use of hydrogen as a rocket propellent and Mr. Baxter also suggested that we should develop nuclear rocket motors. Mr. Stephens replied that we had to be selective and decide which alternative to put our money on. He felt that the best way of reducing unknown factors and achieving reliability was to use staged vehicles propelled by chemically fuelled rockets with a moderately high specific impulse.

AT BUCKINGHAM PALACE.—Sir Aubrey and Lady Burke outside Buckingham Palace after the Royal Investiture on February 10. On the left is their son, Kevin.

Canadian Half-century

AT the beginning of next week falls the 50th anniversary of the first powered aeroplane flight in Canada—and in the British Commonwealth. On February 23, 1909, Mr. J. A. D. McCurdy, flying the Silver Dart biplane over the ice at Baddeck Bay, Nova Scotia, achieved the distinction of becoming the Dominion's—and the Commonwealth's—premier pilot. This historic occasion will be celebrated throughout Canada in a series of commemorative events spread over the next several months. And in this issue we mark the beginning of Canada's aeronautical jubilee year, by an account of McCurdy's flight in the Silver Dart and its background story (see page 224).

During the 50 years that have passed since that significant flight at Baddeck Bay, Canada's aeronautical effort has grown and prospered and played an important part in two World Wars. But the most remarkable achievement in Canadian aviation has, perhaps, been the development during the post-war years of a complete and self-contained aircraft industry capable of supplying the R.C.A.F. with the up-to-date aircraft it requires to play an active part in NATO affairs.

This has meant that not only has this industry had to be fully equipped, but capable of designing and building large supersonic jet aircraft and their appropriate powerplants. Quite apart from the central airframe and aero-engine industry there has had to be built up a large and comprehensive supplementary industry of equipment, accessories and materials suppliers.

We in Great Britain can claim some particular interest in these developments in Canada, for the British aircraft industry has played a considerable part in this building-up process. Indeed, names such as Avro, de Havilland, Fairey, Dowty, Bristol, Rolls-Royce and Lucas-Rotax are as familiar in the Canadian aeronautical scene as they are over here. And no doubt the ties between our two industries will be even closer during the second half of Canada's aeronautical century than they have been during the first.

Leaving Hawkers

MR. A. NEVILLE SPRIGGS, O.B.E., M.I.P.E., has relinquished his appointment as managing director at Hawker Aircraft. This has been brought about by the recent reorganization of the aviation affairs of the Hawker Siddeley

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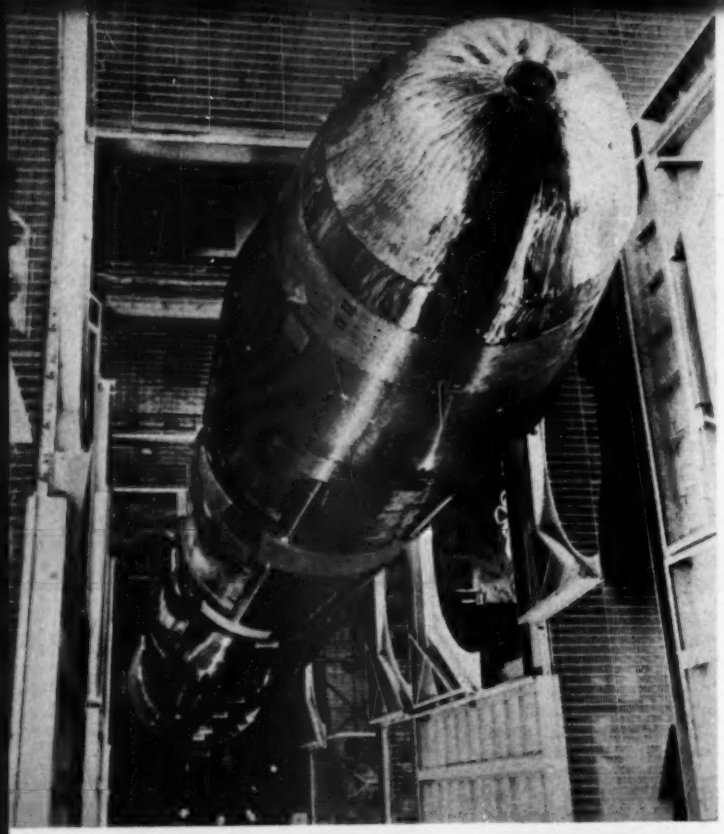
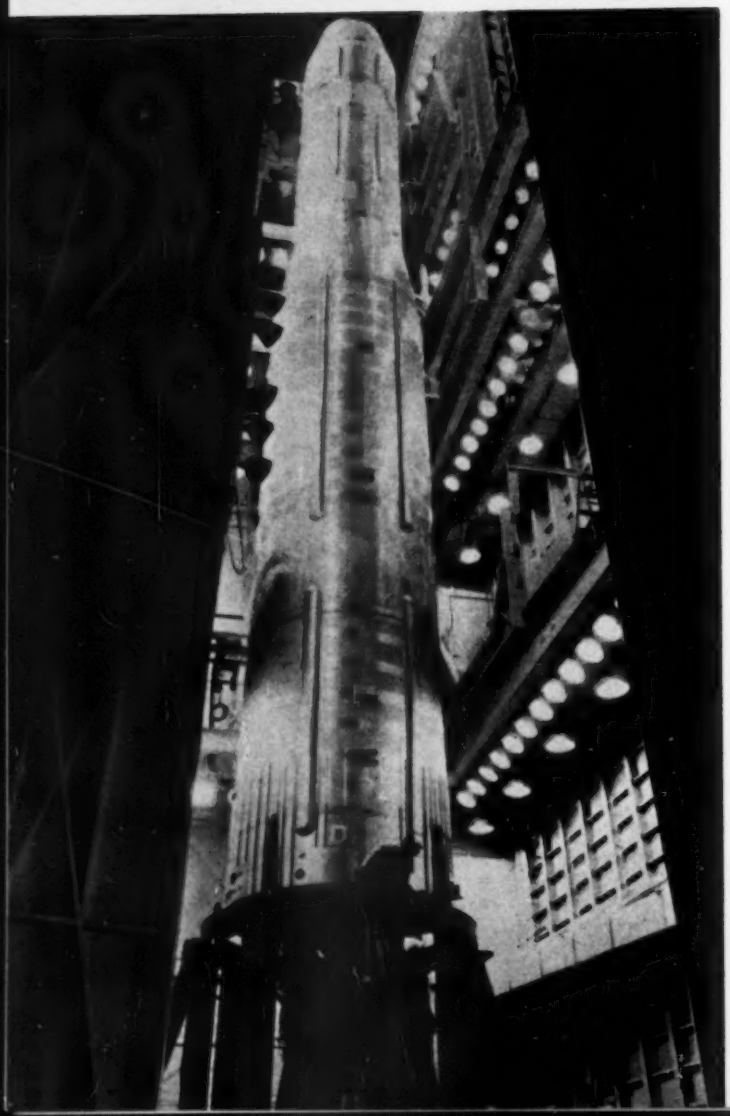




Group and the formation of Hawker Siddeley Aviation, Ltd., to control the Group's new Aviation Division (THE AEROPLANE, January 30). According to the statement giving the news, this reorganization left no position open for Mr. Spriggs "commensurate with his rank."

Neville Spriggs had been with the Hawker company since it was founded, having been apprenticed to the Sopwith Aviation company in 1915. He joined H. G. Hawker Engineering in 1920 and subsequently became works manager of the Hawker group of factories in 1942. He was appointed an O.B.E. in 1943 in recognition of the part he played in the production of Hurricanes and was elected to the board of Hawker Aircraft in 1945.

Comet Contact

ADMIRAL LUI HOH-TU'S denial, on behalf of the Chinese Nationalist Ministry of Defence, that C.N.A.F. Sabres "buzzed" a B.O.A.C. Comet 4 over Formosa on January 30 seems slightly strange in view of our air-to-air close-up of the offending aircraft on p. 215 of this issue.

In the absence of a precise definition of "buzzing," which, however, is usually interpreted to mean something more than the close and unauthorized formation flying of this incident, the Chinese denial may have some factual foundation. The fact remains that one of the pair of Sabres came much closer than the authorized 2,000 yd., appearing first and briefly on the rear port quarter, where the pilot had to squint into the sun to see the Comet, before sliding underneath to a position just off the starboard wing tip. It then stayed there for several minutes, moving gently forwards as the pilot closely inspected the Comet.

A formal complaint was later filed by Capt. R. C. Alabaster when landing at Tainan, Formosa, on the return trip, and a full report on the incident is being made this week to the Ministry by B.O.A.C.

An Italian Contender

DELIVERY of the first production P.166 executive aircraft built by Piaggio and Co., S.p.A., of Genoa and Finale Ligure (see THE AEROPLANE, January 30, p. 128) is scheduled for next month, when the type will be introduced to World markets.

With two 340-h.p. Lycoming engines, the P.166 is a 6-8-seater. It has been developed from the P.136-L2 amphibian by the engineering team directed by Prof. Dott. Ing. Giovanni P. Casiraghi as a direct competitor of the twin-engined business aircraft produced in the U.S.A. which have started to infiltrate into a market neglected by our own industry. This development was instigated by Mr. Francis J. Trecker, of the Trecker Aircraft Corpn., which builds the P.136-L2 under licence at Milwaukee, Wis., as the Super Gull.

The P.166 is not in any way a competitor of the Dove; rather does it meet a requirement between that of the Rapide and the U.S. twins.

Acting as Piaggio's consultant on British and Commonwealth aviation matters is Mr. James Hay Stevens, who is attempting to interest equipment and instrument manufacturers in the supply of as much British material as possible for the P.166.

A Link is Severed

WITH the sudden death on February 10 of Mr. C. B. Collins, O.B.E., at the age of 62, the last link between the present Ministry of Transport and Civil Aviation and the original Civil Aviation Directorate of the Air Ministry was severed. Mr. Collins had been Deputy Director of Aircraft Requirements in the Ministry of Civil Aviation since its inception in May, 1945. From 1947 he was closely concerned with the planning of London Airport.

He entered the Civil Service in 1912 at the Admiralty. He served with the R.N.A.S. from 1916 until the formation of the R.A.F. in which he remained until he joined the Air Ministry in 1919.

He leaves a widow and grown-up son and daughter.

TITANIC THREAT.—Seen here at the Denver plant of Martin, the Titan two-stage ICBM for the U.S.A.F. has a length of about 90 ft. and is 10 ft. in diameter. First successful firing was on February 6. It will be fired from underground launching pads.

London Heliport Progress

THE Town Planning Committee of the London County Council has recommended that London heliports should be sited on the perimeter of the central area rather than in the centre of the city. Three zones suggested are on the bank of the Thames south of Victoria station; to the north of King's Cross and St. Pancras stations, and to the east of the Tower of London.

Reasons given for these locations are their closeness to main-line railway stations, hotels and business houses; that they can easily be reached from the suburbs; that sites are available with better parking and service facilities than in Central London; and that sites are available in largely non-residential areas where fewer people would be affected by noise.

A heliport has already been proposed in one of these areas by Rotorports, Ltd. Its proposal for a permanent heliport at Nine Elms Lane, S.W.8, on the south bank of the Thames, is the subject of a public inquiry to be held by the Ministry of Housing and Local Government on February 25. Some information on this Rotorports' scheme was published in THE AEROPLANE of January 23; more details were given at a Press conference held by the company on February 16.

The Rotorports' site has a 300-ft. river frontage. Development is planned in three stages, the first being the construction of a 150-ft. by 100-ft. landing platform, extending over the river, and a few essential buildings. Completion of this stage will take a little more than a year from the time permission is received for its construction. The second stage calls for expansion and consolidation of the heliport, including the provision of Customs and immigration facilities. Finally the size of the landing platform will be increased and passenger and freight facilities will be extended to cope with scheduled services by large helicopters such as the Fairey Rotodyne.

Capt. John Crewdson, the managing director of Rotorports, Ltd., spoke of his company's intention to operate charter services from the heliport. Although Rotorports has applied for permission to operate scheduled services with Westminsters and Rotodynes, this will not be done until these large passenger helicopters have been in service for two or three years with other operators. In Capt. Crewdson's view only helicopters of this size will be able to operate economic scheduled services.

He considered that the heliport would initially deal with 10-15 movements a week and that the financial return would be limited: it would be augmented by letting out trade concessions at the heliport. The number of movements should increase rapidly, particularly when scheduled services were operated to it, as they might be by Sabena.

If planning permission is received the Nine Elms heliport will be London's second. Westland Aircraft, Ltd., has been given permission to operate a heliport between Battersea Railway Bridge and Wandsworth Bridge for seven years; its construction is now well under way.

Inter-Service Commands

ONE of the more important high-level changes announced in the recent White Paper on Defence is the proposed setting up of a unified inter-Service command in the Mediterranean area and the possibility of a similar arrangement in the Far East. Under this system the forces of all the three Services in each area would come under the control of a single commander, who would have three deputies dealing with land, sea and air operations.

For operational and joint administrative problems the local area commander, who would probably be known as the Commander, British Forces Mediterranean, or Commander, British Forces Far East, would be responsible to the Chief of the Defence Staff (a post to be taken over next July by Admiral of the Fleet Lord Mountbatten of Burma) in his capacity as chairman of the Chiefs of Staff. All other Service problems would be the responsibility of the Ministry concerned.

This system of unified command was introduced in the Middle East on April 1 of last year when the Headquarters, British Forces, Arabian Peninsular, became entirely independent of M.E.A.F. and was made a fully integrated joint Services organization. On the same date Air Headquarters, Levant, was dissolved and the administration of the R.A.F. bases in Cyprus was taken over by Headquarters, M.E.A.F. A third R.A.F. component, Air H.Q., Malta, is also separate.

Photographs copyright "The Aeroplane"

PRESIDENTIAL RECEPTION.—(L. to R., upper and lower). Sir Arnold and Lady Hall received the guests with their daughter, Miss Caroline Hall. Dr. Ballantyne, secretary of the R.Ae.S., with Mr. A. J. Barrett and Mrs. Barrett. Air Cdre. C. L. Dann, Mr. M. B. Morgan, Gp. Capt. J. R. Morgan and Mr. L. F. Nicholson. Sir George Gardner and Mr. J. A. C. Manson. Messrs. Geoffrey Tyson, D. B. Smith and Joe Bradford. Mrs. Bedford, Messrs. Hugh Merewether and Bill Bedford. (Report p. 206.)

A Strategic Transport for the R.A.F.

ONE of the more important items of news last week was the announcement that Short Brothers and Harland had been given the order for the R.A.F.'s new strategic transport. Giving this information in the House of Commons on February 11, in answer to a number of questions, the Minister of Defence said that the Britannic 3—a freighter version of the Britannia—would have loading arrangements in accordance with the Army's requirements and a performance that fitted in very well with that of the Britannias already used for trooping and for the carriage of less bulky freight. In his White Paper published the previous day, Mr. Sandys had explained that the proposal was to order "a small number of long-distance air freighters capable of carrying bulky equipment such as guided missiles and their associated radar vehicles."

As forecast in THE AEROPLANE for November 1, 1957, the Britannic makes use of the standard Britannia airframe components; its fuel, control and electrical systems; and, to a large extent, the undercarriage—but has an entirely new fuselage with rear loading. It has a high wing arrangement in order to reduce ground clearance to a minimum, thus facilitating loading; and it is powered by four Rolls-Royce Tynes.

The original proposal was to use a standard Britannia wing complete with Proteus powerplants. With the use of Tynes, however, one would expect that a certain amount of redesign would be necessary so that it may not be possible to retain a Proteus-type nacelle layout.

The prototype is scheduled to make its first flight in April, 1961, and present plans are for production aircraft to be available at the end of 1961 or early in 1962. A market survey made by the company suggests that there might well be quite a civil future for the Britannic (or Short S.C.5, to give it its company designation) as a long-distance low-cost civil freighter for 1963-64. As a passenger aircraft it will carry 197 passengers at 356 m.p.h. over a still-air range of 2,600 miles for a direct operating cost of 0.77d. per seat-mile.

With a 17.5-ft. diameter the new fuselage has an unobstructed floor at "truck bed height" so that loading can be accomplished with a minimum of vertical movement. The hold proper measures 12 ft. by 12 ft. by 80 ft. 6 in.—of this floor the aft 20 ft. are formed by the hydraulically operated loading ramp which slopes upwards towards the rear when in the closed position; headroom at the extreme end of the ramp is 10 ft. 6 in. The fuselage is fully pressurized to give a cabin "altitude" of 8,000 ft. up to 30,000 ft.

The flight deck portion of the fuselage is a standard Britannia component and accommodation is provided for a crew of five. For trooping, 140 troops can be accommodated on the main hold floor and about 60 more on a removable second floor at the forward end of the fuselage. There is a side door, 7 ft. 6 in. by 8 ft. 6 in., forward for the loading of smaller freight; additional side doors are provided for normal paratroop drops.

On each side of the hold floor there is a "skirting," 2 ft. in height, which provides a walkway that can be used when the hold is loaded. Over the main floor there is a grid of standard lashing points and, similarly, points are provided on the walls to a height of 4 ft.

Heavy loads to be dropped by parachute are lashed to special platforms measuring 16 ft. or 24 ft. These are fitted with air bags on their underside which are automatically inflated during the descent to cushion the landing. Four or two such platforms, respectively, can be carried in the Britannic.

With a design all-up weight of 195,000 lb., the maximum payload is 75,000 lb. which can be carried over a still-air range of 1,400 miles at a mean speed of 360 m.p.h. With full tanks a 30,000-lb. payload can be transported 5,500 miles. A 33,000-lb. payload can be delivered to a 1,000-yard airstrip 860 miles from base and the return journey made with a payload of 30,000 lb.

Principal dimensions of the S.C.5 are: Span, 148 ft. 3.5 in.; length, 134 ft.; height, 47 ft.; and ground clearance, 3 ft. 6 in.

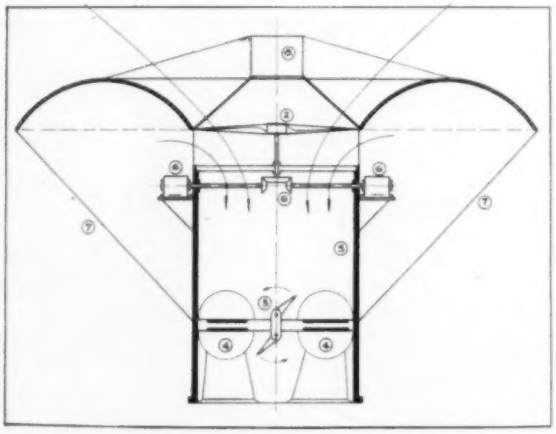
A Pre-War VTOL Project

NOW that the maiden flight of Count von Zborovski's annular-wing Coleopter is imminent, it is an opportune moment to draw attention to an attempt made more than 30 years ago to build an aircraft of similar layout. In 1927 an official circular was issued by the Tenth Department of the Polish Ministry of War, Air Force Command, calling for the submission by the Polish Air Force personnel of ideas for the technical improvement of Service equipment. In response, Capt. Alexander Sipowicz submitted plans for a VTOL vehicle incorporating a wing of annular configuration. He called it the Heliplan.

As can be seen from the accompanying sketch, the Heliplan embodied the principle of the ducted fan. Basically it consisted of a constant-diameter tubular fuselage (5), at the upper end of which were mounted the two engines (6) and transmission drives. At the lower end were attached sets of differentially operated rudders (3 and 4). A large diameter propeller (2) drove air downwards through a circular opening in a dished ring, which was connected to the fuselage by means of four vertical planes (7). The cockpit was mounted above the propeller on a system of struts (8)

The specification submitted by Capt. Sipowicz shows that allowance had been made not only to lift the aircraft from the ground, but to create an airstream inside the fuselage at which the rudders would operate efficiently. These were divided into two groups.

First, two differentially operating surfaces (3) were intended to produce a rotating movement of the craft, about its vertical axis, whilst the action of the other set (4) would move the vehicle about its lateral axis. The dished, circular ring was incorporated primarily as a device to retard descent in the event of engine failure, but it also served to increase the efficiency of



the propeller ducting, creating a dividing plane between the lower air pressure above and higher pressure beneath it.

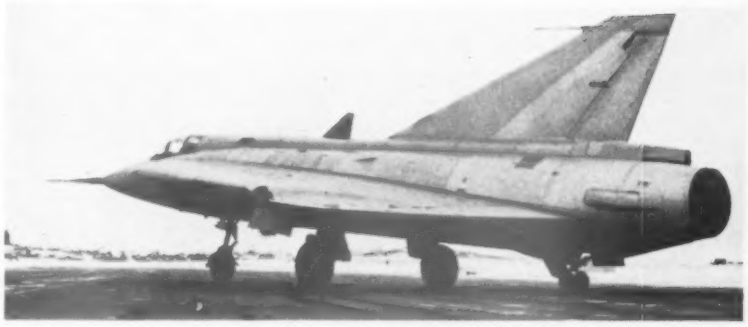
Capt. Sipowicz conducted exhaustive tests with flying scale models, fitted with a 0.5 h.p. power unit, and these showed that a 200 h.p. engine (or two geared engines of 100 h.p. each) would provide sufficient power to lift a machine weighing 1,764 lb. Under these conditions, a propeller of 13 ft. diameter would create an airstream velocity of 65.61 ft./sec., enough to ensure that internal control surfaces would provide an adequate degree of manœuvrability.

The columns of the April, 1929, issue of the Polish aviation monthly *Lot Polski* carried an appeal by Capt. Sipowicz for practical assistance in the completion of his Heliplan. Unfortunately, owing to the loss of many valuable records during the late War, it is not certain if he received such help, or if indeed the machine was ever completed and flown. One thing is certain, however, that the Heliplan was of a very advanced concept at the time, and that it can be regarded as the ancestor of the modern VTOL.—J. ORWOVSKI.

General Aviation News

PARIS PARTICIPATION. — Among the 32 British exhibitors who are to take part in the Paris International Air Show (June 12-21) are Hawker Siddeley, English Electric, Napier, Bristol, de Havilland, Alvis, Blackburn and General, Fairey, Folland, Rolls-Royce, Short, Scottish Aviation and Westland. This, the 50th anniversary show, will be mainly devoted to missiles, and a special enclosure will be arranged for them in front of the exhibition hall at Le Bourget. There will be daily "firing" demonstrations.

MILES SIMULATOR.—Miles Electronics, Ltd., of Shoreham, has been awarded a contract for the design and manufacture of a simulator for the Blackburn NA.39 strike aircraft. Miles has recently completed a simulator for V-bomber flight-refuelling, and one for the Sea Vixen is progressing.



REDUCED-DRAG DRAKEN.—Modifications to the Swedish Saab-35A Draken fighter (Rolls-Royce Avon 200 Series turbojet) include a lengthened rear fuselage, resulting in reduced drag at supersonic speeds, and a retractable dual tailwheel unit instead of a bumper-skid.

MISSILE PRODUCTION.—This large welding fixture is used for missile-shell fabrication at the Chrysler Detroit plant where Redstone and Jupiter ballistic missiles are produced.

NEW NAMES.—Since February 2 Northrop Aircraft, Ltd., has been known as Northrop Corporation; the Northrop Division at Hawthorne, Calif., has been renamed Norair.

SKI-HERCULES.—The Lockheed Aircraft Corpn. has begun delivery of 12 ski-equipped C-130s to the U.S.A.F. for Arctic operations.

CONWAY POWER BOOSTED.—Approval for the Rolls-Royce Conway to operate at 18,000 lb. minimum dry thrust has been granted by the A.R.B. This must be for the R.Co.12 engine, which has a guaranteed minimum thrust of 17,500 lb. The R.Co.10, already delivered to the U.S.A. for the Boeing 707-420 and Douglas DC-8, is approved by the A.R.B. and F.A.A. for a thrust of 17,000 lb., the guaranteed minimum thrust being 16,500 lb.

LYCOMING - HERON. — A D.H. Heron owned by the National Bank of Mexico has been fitted with four 340-h.p. Lycoming GSO-480-B1A6 engines in place of the Gipsy Queens, resulting in a considerable speed increase. The conversion work was done by a team of Mexican engineers led by Ing. Miguel Ballesteros.

NORTHROP LIGHT FIGHTER.—The U.S.A.F. is shortly to sign a contract for the development of the N-156F lightweight fighter produced by the Norair division of the Northrop Corpn. The aircraft is to weigh about 12,000 lb., have a range of 2,000 miles, and be capable of operating from 3,000-ft. runways. The mock-up was illustrated in our issue of April 11 last. The trainer version, the T-38, is in production.

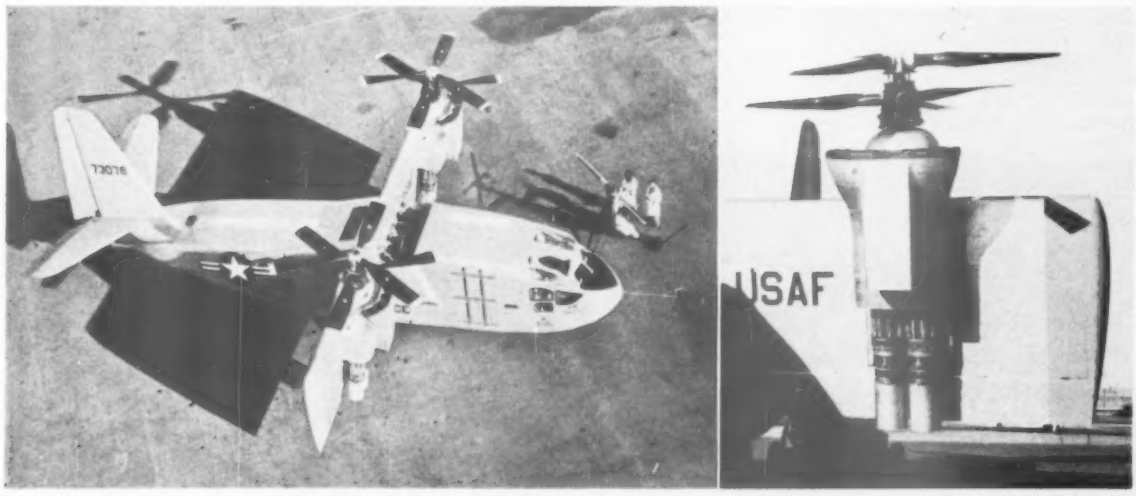
S.C.1 FINANCE.—The Minister of Supply said on February 9 that work on the Short S.C.1 VTOL research aircraft had been proceeding satisfactorily and that an increase in funds had been provided.

Gold is Cheaper

"WORTH their weight in gold" is the way President Eisenhower described "certain bombers"—later identified as the B-58 Hustler, in his State of the Union message. At the current rate of production, the B-58, weighing-in at 47,000 lb., costs $26.7 million or about $567 per lb. Gold costs about $500 per lb.—From *Missiles and Rockets.*

MARTIN REORGANIZATION. — The Baltimore division of the Martin Co. has divided its 2,000-man engineering staff into two divisions—Manned Vehicles and Missiles-Electronics.

MORE NEWS ITEMS ARE ON PP. 229-230



Howard Levy Photographs

WING TILTER.—Main powerplant for the Hiller X-18 VTOL aircraft is a pair of Allison T40 coupled turboprops driving contraprops. A Westinghouse J34 turbojet in the fuselage provides compressed air for tail "puff pipe" control used in VTOL flight. The pivoting wing is rotated through a right-angle after take-off.

Air Transport

The Battle of Montreal

THE long-awaited ICAO conference on short-range navigational aids (professionally known as a COM/OPS/RAC meeting) began on February 10. The question to be resolved at the meeting is, in over-simplified form, whether the present ICAO international standard, the VHF—or visual—omnidirectional radio range (VOR), with the addition of distance-measuring equipment (DME) based on the U.S. Navy/Army Tactical Air Navigation System (Tacan), should continue to be accepted after 1965, or whether this should now be supplemented and, later, succeeded by an area-coverage aid (represented by the Decca system).

The two major protagonists are the U.S.A. and the U.K. The history of the battle goes back to 1946 when the VOR (point-source) standard was approved (with the proviso that it should be supplemented in due course by DME) against the advice of the U.K. who were then in favour of the area-coverage principle which, in those days, was exemplified by Gee. At the time of going to press the main ex-parte supporters for each system have been the International Air Transport Association (for VOR/DME or Vortac) and the International Federation of Air Line Pilots Associations (for the area-coverage principle).

The general trend of the meeting last week was shown on the first day when a U.K. motion, to the effect that long-range-system requirements should be kept in mind when discussing short-range aids, was (extraordinarily but not surprisingly) defeated by 14 votes to nine, with nine abstentions.

Some of the considerations behind the U.K. and U.S.A. viewpoints were given in THE AEROPLANE of January 23 (p. 92) and January 30 (pp. 120-121). By way of postscript to these comments it might be added that a team formed by Mr. E. P. Curtis to make a comprehensive study, for Gen. Eisenhower, of future aviation facilities in the U.S.A. offered a report which pointed out the inadequacies of point-source VHF/UHF systems such as Vortac or VOR/DME and the advantages of a hyperbolic area-coverage system.

B.E.A.-Air France Pool

THAT Air France backs British European Airways' attempts to reduce air fares in Europe was made apparent last week, when a pooling agreement between the two operators was concluded. The five-year agreement becomes effective on April 1, and will result in an integration of B.E.A. and Air France timetables on the London-Paris and London-Nice routes, to provide better service. Revenues on these routes will be shared between the two companies in mutually agreed and annually revised proportions based on the previous season's results and other factors.

Although B.E.A. at present carries rather more than half the total traffic on these routes, this position may well be reversed after May 15, on which date Air France will begin to introduce the Caravelle into regular service. With the introduction of new equipment (B.E.A. will be phasing-in the Vanguard and Comet 4B in 1960) both airlines hope to be able to introduce economy-class fares some 15-20% below the normal tourist level—subject to IATA agreement.

Rising Overheads

INCREASES in landing fees and passenger service charges levied by the Ministry of Transport and Civil Aviation at U.K. airports were to be expected, but will be no more welcome to the operators for that. It is inevitable that airport authorities should seek to recoup, to some extent, the steadily increasing cost of providing adequate airport and airway facilities.

Full details of the increases have not yet been worked out, but the revised landing fees are expected to yield an additional £660,000 in a full year at the present level of operations—an increase of some 28%. The passenger service charge, applicable to each person departing from the U.K., will be increased by 50%, from 5s. to 7s. 6d., for an annual yield increase of about £220,000.

See and Be Seen

DETAILS were given, earlier this week, of the experiments conducted by the M.T.C.A. with fluorescent paints as an aid to aircraft visibility. Although the value of these paints, especially in shades of red or orange, has been known for some time, particular attention has to be paid to the pattern of markings if maximum value is to be obtained from their use. The Ministry, after experiments with Chipmunks, has now scientifically treated areas of a twin-engined President, which, seen at a misty L.A.P. last Monday, certainly showed something of the value of the system. Orange has been found to be the best colour and all the Ministry's 15 aircraft are to be treated.

Helicopter Operators Confer

REPRESENTATIVES of five airlines interested in scheduled helicopter operations met in London last week to consider recent developments in the helicopter transport field and to exchange views on aspects of helicopter design, navigation, ATC and performance requirements. The chair was taken by Capt. J. W. G. James, O.B.E., flight operations director of B.E.A., and other airlines represented were Alitalia, Chicago Helicopter Airways, New York Airways and Sabena.

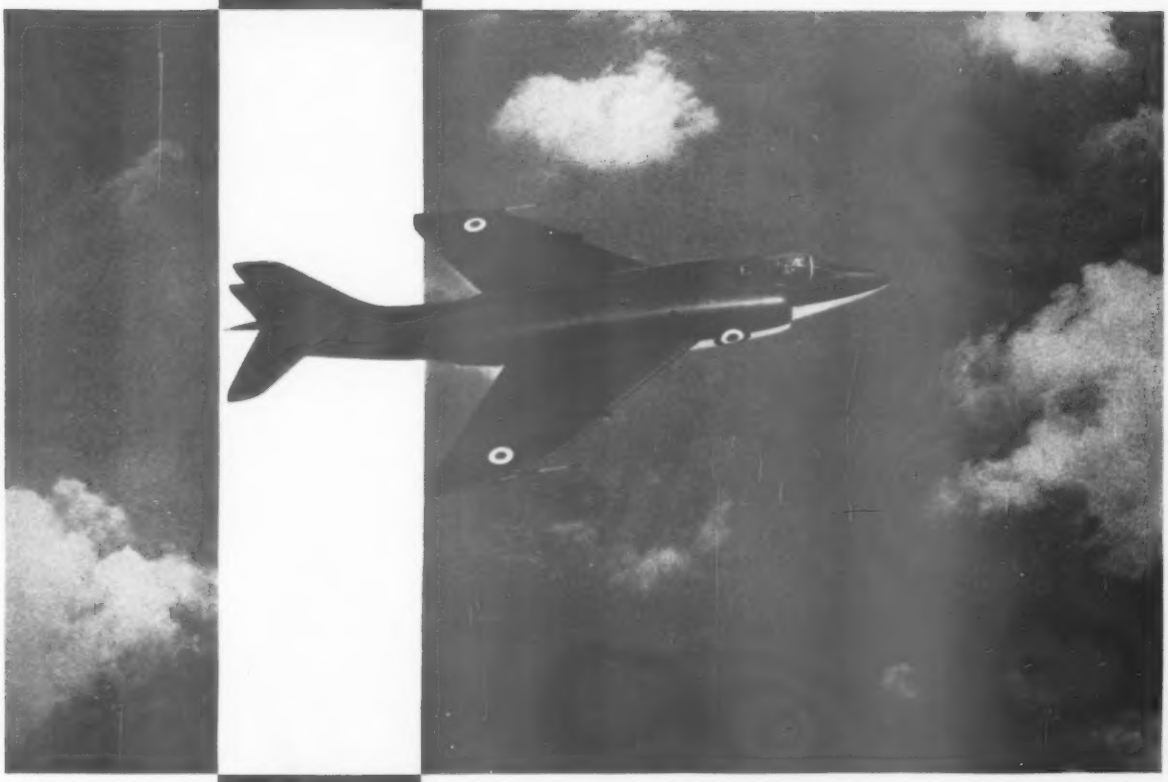
The group considered that the advent of multi-turbine types of rotary-wing aircraft capable of all-weather flight with reasonably economic characteristics, is likely to lead to a large-scale expansion of city centre-to-city centre helicopter services. A reduction in the minimum size of heliports might become possible. Work on noise suppression or attenuation should be encouraged. A low-frequency hyperbolic area-coverage system with pictorial cockpit presentation offered the most immediate promise for low-altitude navigation in the terminal area and en route.

A report of the meeting's conclusions is to be submitted to IATA for review by the technical committee. All the airlines concerned are members or associate members of IATA.

HARD AT IT.—Helicopter operators in committee during last week's meeting reported above. From left to right round the table they are: F. W. Free (B.E.A.); J. E. Gallagher (N.Y.A.); Capt. A. V. J. Vernieuwe (Sabena); Capt. G. A. J. J. Prémérie (Sabena); Capt. L. Blondiau (Sabena); G. Gobert (Sabena); R. C. Morgan (B.E.A.); B. S. Shenstone (B.E.A.); J. W. Reid (B.E.A.); Miss J. Upton (secretary); Capt. J. W. G. James (B.E.A.); O. H. Wiles (secretary); Count A. M. Farini (Alitalia); R. H. Whitby (B.E.A.).

Photograph copyright "The Aeroplane"

SUPERMARINE



Scimitar

The Scimitar is the Royal Navy's most powerful air armament. A single-seat twin-jet strike fighter, it is capable of delivering a tactical atom-bomb and can also fulfil interceptor and reconnaissance roles. The airframe is strongly built to meet the high stresses of low-level strike work, and can sustain air speeds well above Mach 1 at sea-level. Power controls are fitted and 'blown flaps' reduce the safe approach speed for deck landing. Nose and wings fold for carrier stowage. Power plant: two Rolls-Royce Avon 200 series turbo-jets.

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED SOUTH MARSTON WORKS SWINDON

TGA AT618

C

STRAIGHT UP . . . *and off she goes!* The first world speed record for "convertiplanes" was recently set up by a Fairey Rotodyne vertical take-off airliner flying a 100 kilometre closed-circuit course at a speed of 190.9 m.p.h.* This creates an absolute speed record for rotorcraft of all types. It is 49 m.p.h. faster than the current 100 kilometre closed-circuit record for helicopters and 29 m.p.h. faster than the world absolute speed record for helicopters (both held in the U.S.A.). The Rotodyne takes off and lands vertically as a helicopter, but in forward flight it flies as a conventional twin-turboprop aircraft with the rotor windmilling.

**Subject to confirmation by the F.A.I.*

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Bell Landing System Details

FURTHER information on some of the technical details and operational aspects of the Bell Aircraft Automatic Landing System has become available since the aid was briefly described in THE AEROPLANE of July 25, 1958 (p. 132).

The system, which requires no additional airborne electronic equipment, employs a precise ground-based automatic tracking radar and command computer. A short "funnel" approach technique is used and the position-measuring and computation functions are performed by the ground-based equipment, which also makes allowances for variations in aircraft aerodynamics and flight-path geometry. To complete the closed loop, a data link is used to transmit the ground-derived commands to the aircraft where they are interpreted by the pilot or are fed direct into the autopilot.

For an aircraft with a touchdown speed of 100 knots and requiring a vertical touchdown velocity of about 2 ft./sec., the Bell system is stated to have an accuracy of control which will provide a lateral position error within ±15 ft. of the runway centreline and a vertical error of about ±1 ft. for 68% of all landings. The ±1 ft. vertical error with the conditions already stated will give a landing within ±167 ft. of the desired touchdown point.

Control is provided in the vertical and horizontal planes. In the vertical plane altitude commands, generated as a function of range-to-go, are compared with the radar-measured altitude of the aircraft. Altitude errors are filtered in the pitch command computer and transferred into pitch commands to be forwarded via the data link to the autopilot. In the lateral system, bank-angle command is generated as a function of the cross-track velocity with an integral term added to wash out errors due to trim and component drift.

In the following brief description of a typical landing operation procedure it is assumed that the aircraft is following an ILS localizer with a horizontal error of not more than 6,000 ft. at four miles from touchdown; that it is in level flight approaching the glide path; and that it has an ILS coupler to introduce pitch and bank commands into the autopilot.

Lock-on by the landing system will occur at a range of four to five miles in fair weather and at a shorter distance in very heavy rain. At radar lock-on the pilot closes the guidance loop by shifting to an ILS frequency which is modulated by the pitch and bank commands generated by the ground equipment. The pitch command will normally be zero when this engagement occurs, implying that the aircraft should continue in level flight. Lateral correction starts immediately.

When the aircraft reaches the command glide path, which should coincide in space with the ILS glide slope to facilitate monitoring in aircraft with two ILS receivers, the ILS indicator will show a "fly down" signal. On reaching the flare-out range, the altitude-command path curves and the aircraft's attitude is rotated nose up by an appropriate pre-computed quantity. A few seconds before touchdown a signal is sent in order that the pilot or autopilot may kick off any drift caused by crosswind. If the radar unlocks prior to touchdown the transmitter power is cut off and the ILS meter flags rise to indicate wave-off.

The major source of error of this closed-loop system is turbulence and the aid is capable of accepting conventional aircraft with approach speeds of 50 knots to more than 250 knots. The acceptance gate is located two to four miles from touchdown and aircraft with a lateral position error from the centreline of not more than one mile at four miles' range and a heading closing angle not greater than 60° may be landed without difficulty. At lock-on the altitude gate is 800 ft. and its location can be changed to accommodate aircraft with glide slopes between 1° and 14°. With a two-radar landing system and a four-mile gate, the maximum landing rate is stated to be one aircraft per minute if the average closing speed is 120 knots.

Operating and Traffic Statistics

FINAL statistics for the year ended March 31, 1958, have been issued by the M.T.C.A. covering the operations of the two Corporations and the private companies with Associate Agreements for scheduled services. Two of the relevant tables are reproduced below. They show total operations for the year compared with those for the year before, and some particularly interesting average load and length of haul values.

The tables are largely self-explanatory, but it should be explained that domestic services comprise those flown by B.E.A. or private companies entirely within Great Britain, the Isle of Man, the Channel Islands and Northern Ireland; all other services come under the international heading. Inclusive Tour services operated under Associate Agreements are not included in the results tabulated; in the year under review, they accounted for a further 91,324,000 passenger miles (137,416 passengers) and 8,333,000 load short-ton miles at load factors, respectively, of 88.3% and 83.9%.

It will be seen that the associate companies were responsible for about 7.7% of the total load ton-miles flown on scheduled service, or 10.1% when the inclusive tour services are added. One feature of the statistics is the general reduction in load factors in 1957/58. This could be attributed in part to the introduction of new large-capacity types of aircraft.

UNITED KINGDOM AIRWAYS CORPORATIONS AND ASSOCIATES

Scheduled services: Financial years 1957/58 and 1956/57

		Capacity short ton-miles	Load short ton-miles (×000)				Overall revenue load factor, %	Seat miles available (×000)	Passenger miles flown (×000)	Passenger load factor, %	Aircraft miles flown (×000)	Passengers carried	Cargo carried (short tons)	
			Total	Passenger	Freight	Mail							Freight	Mail
All services	1957/58	513,325	315,107	234,443	56,833	23,834	61.4	3,759,154	2,437,622	64.8	85,670	3,990,746	115,219	11,616
	1956/57	445,865	284,241	208,778	51,668	23,794	63.8	3,204,591	2,158,447	67.4	79,426	3,490,961	102,014	11,739
	% change	+15.1	+10.9	+12.3	+10.0	+ 0.2		+17.3	+12.9		+ 7.9	+14.3	+12.9	— 1.1
Domestic services	1957/58	49,709	30,073	27,805	1,787	481	60.5	459,025	314,061	68.4	13,979	1,583,711	12,625	2,789
	1956/57	41,592	26,273	24,135	1,657	480	63.2	381,295	274,294	71.9	12,566	1,413,435	12,770	2,822
	% change	+19.5	+14.5	+15.2	+ 7.9	+ 0.2		+20.4	+14.5		+11.2	+12.0	— 1.1	— 1.2
International services	1957/58	463,616	285,034	206,638	55,043	23,353	61.5	3,300,129	2,123,561	64.3	71,692	2,407,035	102,594	8,827
	1956/57	404,273	257,968	184,643	50,011	23,314	63.8	2,823,296	1,884,153	66.7	66,860	2,077,526	89,244	8,917
	% change	+14.7	+10.5	+11.9	+10.1	+ 0.2		+16.9	+12.7		+ 7.2	+15.9	+15.0	— 1.0
B.O.A.C.	1957/58	313,288	189,645	131,872	37,572	20,201	60.5	2,094,803	1,326,047	63.3	40,161	459,144	8,915	4,103
	1956/57	274,932	175,176	120,355	34,689	20,132	63.7	1,817,465	1,200,332	66.0	38,441	395,989	8,377	4,146
	% change	+14.0	+8.3	+9.6	+8.3	+0.3		+15.3	+10.5		+4.5	+15.9	+6.4	—1.0
B.E.A.	1957/58	159,466	101,246	86,352	11,295	3,600	63.5	1,365,094	935,756	68.5	32,972	2,765,591	28,218	7,465
	1956/57	138,221	88,828	74,799	10,406	3,623	64.3	1,150,792	808,872	70.3	29,877	2,461,065	25,770	7,541
	% change	+15.4	+14.0	+15.4	+ 8.5	— 0.6		+18.6	+15.7		+10.4	+12.4	+ 9.5	— 1.0
Associate Companies	1957/58	40,571	24,216	16,219	7,963	34	59.7	299,257	175,820	58.8	12,537	766,011	78,086	49
	1956/57	32,711	20,237	13,624	6,572	40	61.9	236,334	149,244	63.1	11,108	633,907	67,867	53
	% change	+24.0	+19.7	+19.0	+21.2	—16.3		+26.6	+17.8		+12.9	+20.8	+15.1	— 7.9

AVERAGE LOADS AND AVERAGE LENGTH OF HAUL

	B.O.A.C.			B.E.A.			Associate Companies		
	All services	Eastern area	Western area	All services	International	Domestic	All services	International	Domestic
Average capacity (lb.)	15,602	15,440	15,912	9,673	10,249	8,313	6,472	7,560	4,288
Average revenue load (lb.)	9,444	9,447	9,439	6,141	6,596	5,067	3,863	4,540	2,504
Average seats available	52	48	61	41	43	38	24	25	22
Average passenger load	33	30	39	28	29	26	14	14	13
Average passenger journey (miles)	2,888	3,741	2,162	338	442	210	230	290	157
Average freight haul (miles)	4,214	4,764	2,942	400	471	197	102	105	65
Average mail haul (miles)	4,923	5,477	3,544	482	666	173	692	822	27
Average length of stage flight (miles)	1,065	1,044	1,107	282	425	157	168	179	150

Eastwards by Comet—Part 2

Navigational, let-down and diversionary procedures on the B.O.A.C. Comet 4 proving flight to the Far East are discussed in this instalment by JOHN FRICKER.

ON the six proving flights which are being completed to the Far East before the introduction of scheduled services with the Comet 4 on April 1, two let-downs are being undertaken at each transit airfield for familiarization purposes by the supernumerary captains and crews. Primary aid for the let-downs is ILS, assisted by VOR where it is available, which is mostly in the Western sectors. In the absence of ILS eastwards of Calcutta, MF beacons near the airfields, or as locators on the end of the runways, are used. The Smiths Flight System in the Comet 4 has autopilot coupling for ILS or VOR let-downs and approaches to 400 ft., although, at the moment, manual let-downs with this system are apparently much more stable and free from oscillation.

To cover the greatest distance per pound of fuel, let-downs are done at 1,200-1,500 ft./min., with the inner pair of Avons idling and the outers at sufficient r.p.m. to maintain the desired temperature and flow of air in the cabin. The air-brakes are not normally used except occasionally on the final stage, and let-downs must be started 150-180 miles out from the destination airfield, necessitating a precise position check before descending.

For most of the route this check is done either by using the Ekco storm-warning radar for map-painting, or by DME, for which ground equipment is installed at every airfield used regularly by B.O.A.C. At the moment, however, only the DME receiver aerials (the small di-electric strips on each side of the nose) are fitted to the Comet 4s, the transmitter knife aerial under the cockpit having been removed because of icing difficulties on the North Atlantic route. A new aerial location, with heating, is being tested at the moment, and DME should be available by the time Comet schedules to the Far East begin in April.

Although expensive to operate, since no other airline uses the equipment, DME is invaluable in the sparsely equipped Eastern sectors, and in addition to giving a direct indication of range, to an accuracy of one nautical mile, can be used to give a rough bearing within about 15°.

Let-downs are continued, depending on local safety heights, other traffic and weather, to an overhead height which may be a holding altitude of 25,000 ft. if there has been no precise groundspeed check, or in the case of heavy traffic or marginal weather. Normally, however, when no delay is expected, the Comet can hold at normal piston-engined heights below 10,000 ft., and still make several attempts to land, within the available fuel reserves (a minimum of 6,000-7,000 kg. at the moment), before diverting.

This was demonstrated on several occasions during the outward proving flight. On the Istanbul-Teheran leg, for example, where a fairly representative fuel load of 24,550 kg. was carried for a sector distance of 1,099 n. miles with a take-off weight of 65,290 kg. (143,939 lb.) there was a partial diversion from the flight plan. Because of poor HF communications, which are normally very patchy on the Eastern route, but were then particularly affected by sun-spot activity, no weather reports were received until within VHF range.

Mehrabad airport, Teheran, then reported freezing rain and a 450-ft. ceiling and 2-km. visibility—which were below minima for this airfield. Although the specified alternates, for which 2,300 kg. plus holding fuel was being carried, were Baghdad and Bahrain, the captain decided to use the additional margin, for the second let-down at Teheran, to take us on to Karachi. We continued at our peak operating altitude for 15 min. past Teheran, which then reported an improvement in the weather. The Comet thereupon returned, made two let-downs and landed after nearly four hours' flying with 8,640 kg. of fuel remaining for a landing weight of 49,380 kg.

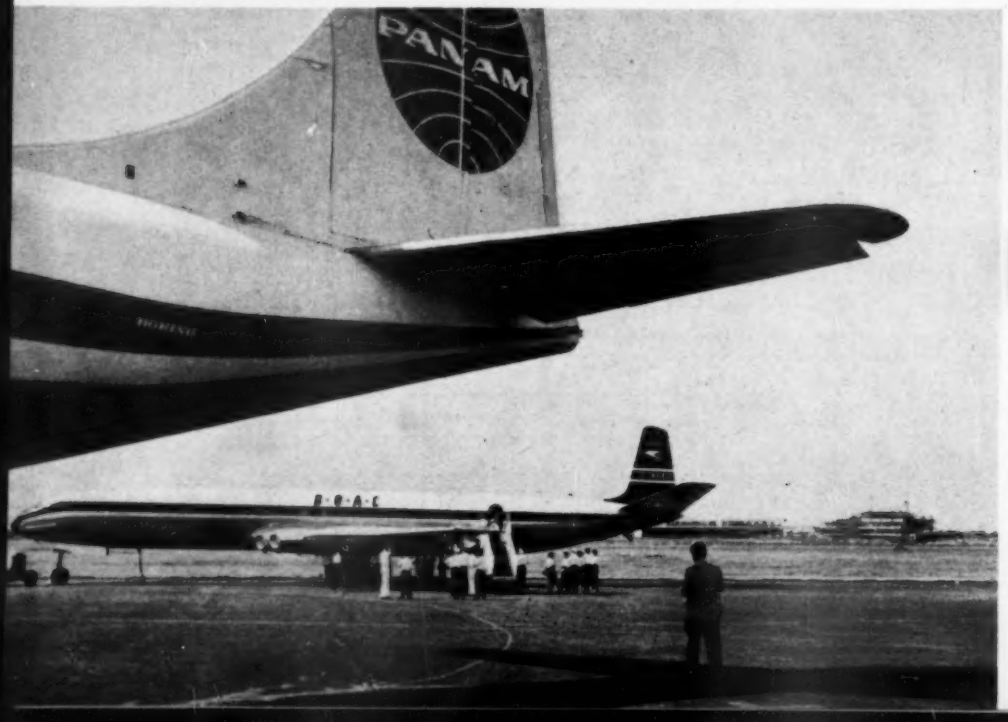
The first complete diversion came on the next leg, planned as 1,654 n. miles, from Teheran to Delhi. This was flown at night, with the theoretical aid of non-directional MF beacons (NDBs). As so often in that part of the World, the Zahedan NDB was apparently not transmitting, and the flight was therefore continued on DR. When north of the Nawabshah NDB its signal was so weak and the bearing so unreliable that the navigator went on to astro.

Delhi then reported fog and below-minima conditions, but, on turning back to Karachi as the nearest alternate, the Comet crew found that a jet-stream of something like 100 knots, undetected because of the lack of navigational aids, had blown them much nearer their original destination than at first thought. Nevertheless, 9,550 kg. of the 25,000 kg. fuel at take-off remained after a flight time of 3 hr. 55 min., giving a landing weight of 50,050 kg.

Karachi has an excellent record as a clear-weather airport, although its present 7,500-ft. runway is not long enough for bigger jets than the Comet when operating with a full load. A 10,500-ft. runway, parallel with the present strip, was started last spring, and should be ready fairly soon for hot-weather jet operation.

On the next leg, flashing past numerous kitehawks spiralling on motionless wings in dusty columns of air, during the

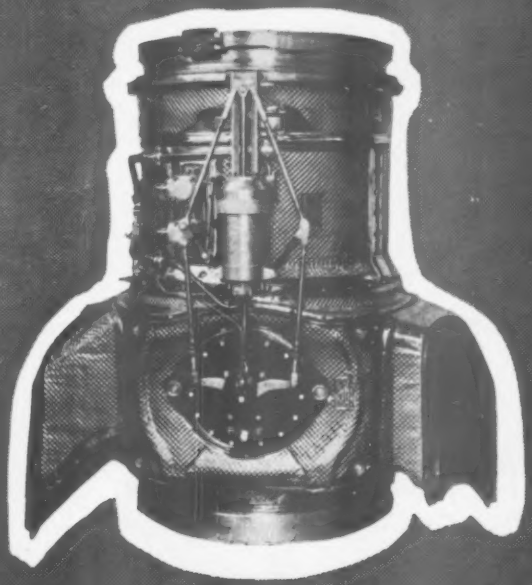
(*Continued on page 215*)



Capt. R. C. Alabaster, Flight Captain, B.O.A.C. Comet Fleet, who commanded the first Comet 4 proving flight to Tokyo, and is to fly the Prime Minister to Moscow for his forthcoming visit.

Sizzling on the tarmac at Manila Airport, in the Philippines, the Comet 4 is framed by the tail of a P.A.A. Stratocruiser. In the background are the new terminal buildings under construction.

Photographs copyright "The Aeroplane"



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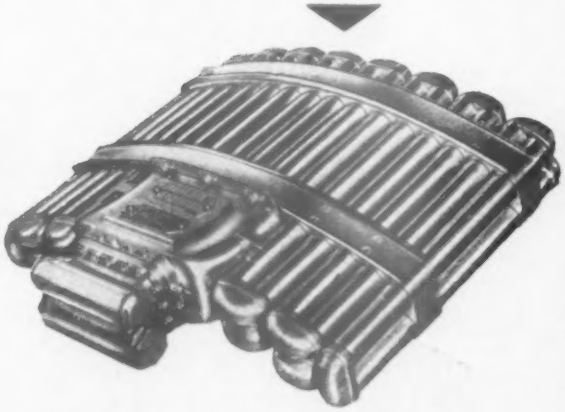

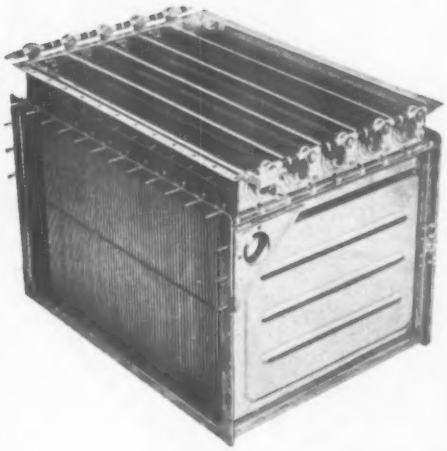

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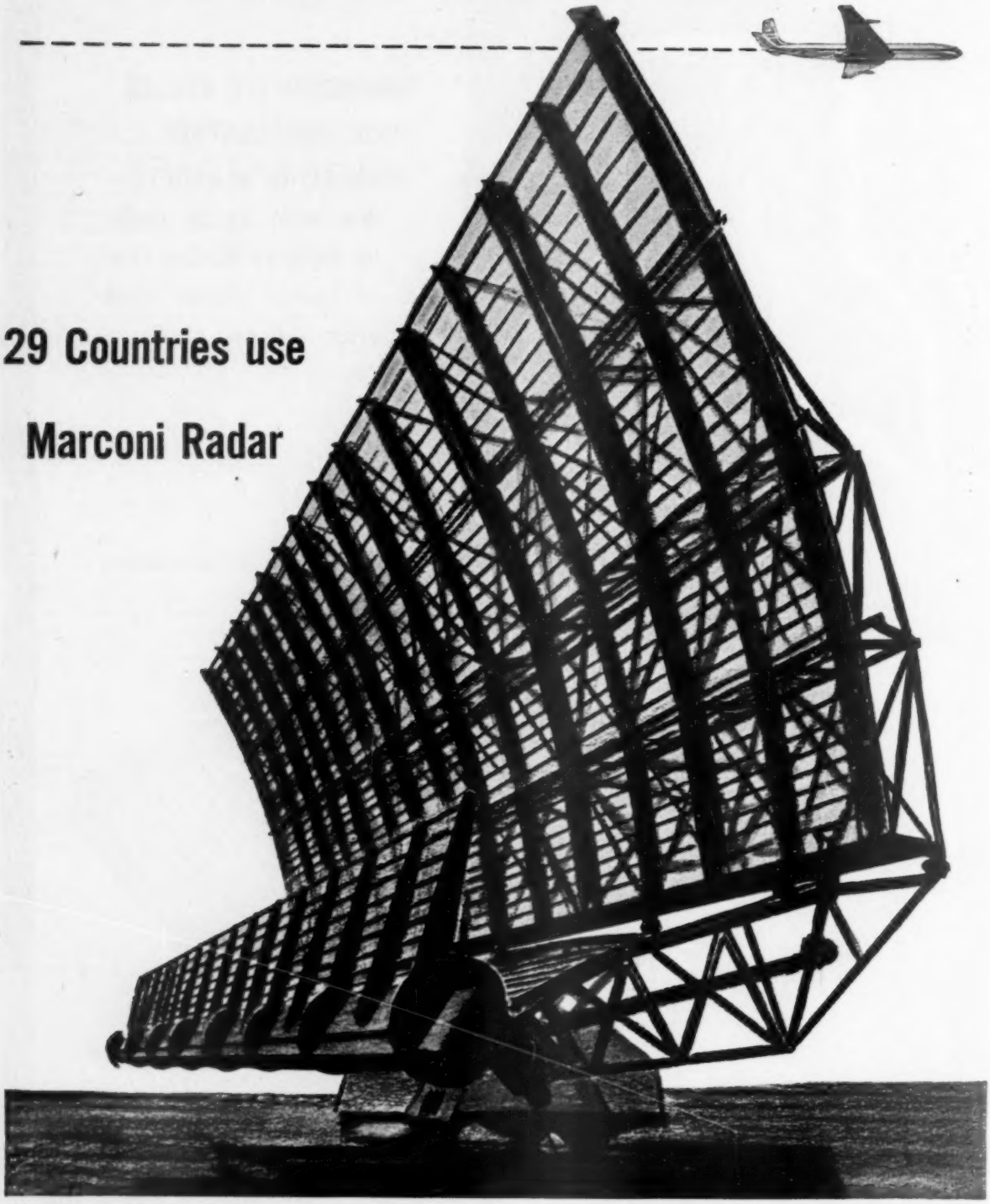
Marconi in Radar



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(*Continued from page 214*)

let-downs at Delhi, provided a reminder of hazards additional to normal flight-planning in the East.

These large birds are most frequently found between 1,000 and 2,000 ft., and sometimes up to 8,000 ft. They are put into the shade, however, by the national pastime of kite-flying in Thailand. One of the captains on board mentioned having seen a large kite apparently hurtle past his cockpit while over Siam at 16,000 ft. in a Constellation, and others have been reported up to 22,000 ft.

A minor problem which became evident on the flight was the common experience of windscreen misting and heavy condensation in the cockpit during let-downs. The screen-misting is not serious, but water dripping into electrical and other equipment can cause trouble. The effect of this, from a rather different cause, was graphically illustrated on take-off from Calcutta, when a fire-warning indication was received on take-off between V_1 and V_2 speed.

Being committed, the take-off was continued, but immediately afterwards all the electrics—for fuel booster pumps, emergency controls, instruments and so on—cut out, indicating that the inertia crash switch had been actuated. The flight engineer promptly dived down into the forward freight hold to reconnect the batteries to the electrical system, while the supernumerary captain in the left-hand seat, Capt. Payne, brought the Comet round for an immediate emergency landing.

As a fire-warning indication had been received it was not permissible to jettison fuel and the Comet had to be landed at its take-off weight of more than 60,000 kg.—some 8,000 kg. above the normally permitted maximum. With about 10 knots additional approach speed Capt. Payne made a smooth touch-down about eight minutes after take-off and, apart from the heavy braking that was needed to decelerate the aircraft within Calcutta's 7,000-ft. runway and the stream of fire engines which followed us, the landing was uneventful. It is probably apocryphal, but the story goes that the captain, when asked if he had sent out a "Mayday," answered, "No. I just said we were on fire."

It is this sort of situation for which the Comet's reverse thrust—to be introduced within the next few months and mandatory only for landing at Kuala Lumpur—will be invaluable, although it is one seldom likely to happen in future. It transpired that drainage from the galley had penetrated the forward baggage hold and the inertia time-switch, which had short-circuited on take-off. This set off the fire extinguisher system in the baggage, engine and equipment bays, the CO_2 vapour actuating the fire-warning system and the time relay then disconnecting the electrics.

Although trivial, the incident caused several days' delay while a new switch and recharged extinguisher bottles were obtained from London and the Comet was thoroughly inspected—but it provided an excellent demonstration of the value of the proving flights as well as the tractability of the Comet.

Our sudden return to Calcutta also emphasized the improvement required in the ground-handling facilities at many airports to match the progress of jet flying. An unscheduled arrival can easily overcrowd the passenger transit accommodation even now at places such as Calcutta, Delhi and other points along the route, and the thought of several of the bigger 150-seat jets arriving simultaneously, because of diversions or altered schedules, is too harrowing to contemplate.

Calcutta is coping with the operating side by extending its present runway to 8,500 ft., and re-surfacing a parallel strip, but a corresponding improvement is needed in passenger handling and transit accommodation.

The most interesting sector of the Tokyo route is undoubtedly that between Bangkok and Hong Kong. This is flown across Thailand, Laos and Central Viet Nam (Tourane) over a route

Photograph copyright "The Aeroplane"

A mutual (and too-close) look was afforded by this F-86F of the Chinese Nationalist Air Force, which flew alongside the Comet over Formosa for several minutes at 37,000 ft.

distance of 1,026 n. miles, but several other considerations determine its operating procedures. Although the new runway extending out into Hong Kong harbour has improved the airfield situation in the Colony, the surrounding peaks still leave only two narrow and winding avenues of approach which must be negotiated visually.

Although the limiting cloud base is as low as 4-500 ft., the horizontal visibility must be at least 2,000 yd., and at the moment there are no aids except beacons at the two holding points marking the beginning of the approaches. Until the line and bar approach lighting is installed on poles in the water (which led to the comment that the only things unable to get into Hong Hong harbour soon will be ships) and ILS aimed through the Lyemun Gap as a track-guidance aid, operations are restricted to daylight and fairly high limits specified. There is some fear that the ILS beam will be deviated by mineral ores in the mountains, while, as Hong Kong is in the typhoon area, cross-winds are another limiting factor.

To complicate matters further, accurate met. forecasting is difficult because of the lack of reports from the Communist Chinese mainland, while political considerations also rule out the use of the excellent White Cloud airfield at Canton as an alternate. This is used by non-communist countries such as India, but apparently would be open to British operators only if they prohibited American passengers from being carried.

The nearest available alternate is therefore at Tainan, on the Nationalist Chinese island of Formosa, some 305 n. miles from Hong Kong. Unfortunately this is affected by the same weather as Hong Kong, and the two airfields are therefore frequently below limits at the same time. This leaves only Manila International Airport, in Luzon, Philippine Republic, some 620 n. miles away, and diversionary fuel must be carried for this alternate on the Hong Kong sectors.

Fortunately the Comet takes this sort of situation in its stride, and the fuel load for the Bangkok-Hong Kong leg of 25,000 kg., with 4,150 kg. for diversions, was no more than that carried on the Istanbul-Teheran, and Teheran-Delhi sectors for a similar gross weight of 65,000 kg. It was also well below the maximum permissible fuel load of 31,000 kg., and, as a matter of interest, the take-off run, at 35 sec. and 72° F. air temperature, was 5 sec. shorter than that at Teheran's 4,000-ft. altitude at around freezing point.

A LORAN chain between Bangkok and Tokyo is of great

After clearing the Lyemun Gap on the south-easterly approach to the new runway at Hong Kong, pilots have a clear and straight approach across the harbour. The old Kai Tak airfield can be seen on the right of Kowloon.

On the last stage of its outward proving flight, G-APDC lets down with the help of air brakes over Tokyo Bay and its beds of edible seaweed.

Photograph copyright "The Aeroplane"

assistance to navigation on those sectors and, with its help, the Comet was overhead Hong Kong in less than three hours as the dawn came up like thunder, and having let down from 37,500 to 7,000 ft. Below was a flat sheet of almost unbroken stratus, with two ominous black peaks protruding from its smooth surface, as we looked past the wings, with their familiar skin pattern of frost over the individual fuel tanks and their supercooled contents.

Kai Tak (Hong Kong) reported that the visibility was about one mile and we continued holding for nearly 40 minutes in the hope of improvement but, instead, conditions began to deteriorate further. We then climbed back to operating height for Tainan, where we soon heard, however, that visibility was equally bad. The diversion was therefore completed by flying the long haul to Manila, which was reached 4 hr. 45 min. after leaving Bangkok, with 8,000 kg. of fuel left in the tanks.

With a ground temperature of 80° F. at about eight in the morning, Manila was the hottest airfield encountered by the Comet on the outward flight. On the leg back to Hong Kong, however, after the weather there had improved an hour or so later, the take-off remained as brief as usual. In such ground temperatures, the main requirement, from the passengers' point of view, was for a cabin air conditioning unit, which is provided at the normal B.O.A.C. transit airfields. We had relished the billowing cold fog, with which it filled the entry region in the front cabin, at Rangoon and Bangkok, but presumably economy prohibits the stationing of a ground conditioning unit at such a remote alternate.

At the second attempt, Hong Kong was clear, and we held briefly above the safety height of 4,500 ft. over the south-east entry point at Waglan Island, with its NDB, VDF and DME responder facilities. Letting down to 500 ft. out to sea, one lines up from Waglan on white-painted cliffs on the next island, and then continues to skirt the mass of Hong Kong island on the left, before squeezing through the Lyemun Gap in a gentle left-hand turn.

There does not appear to be a great deal of room between the wing tips and the two converging points of island and mainland, and although this is to a certain extent illusory, pilots happily accept the challenge of flying skill which is demanded. It is quite apparent from our experience that the Comet lends itself well to the low-speed manœuvres required to negotiate either of the approaches to the new runway extending out to sea from Kowloon.

From the south-eastern approach, passing through the gap brings one directly in line with the 31 or sea end of the 8,500 ft. runway, where we made a landing before back-tracking for another circuit. This was done from the same direction, taking us over the 13 approach end and teeming Kowloon in our usual spectacular climb, followed by a low-level circuit of Hong Kong island and a final landing at 52,500 kg. aircraft weight, including 12,000 kg. of fuel.

The new strip at Hong Kong is a great improvement over the now-disused airfield alongside, but night operations when they eventually start should be full of interest for passengers and crews. One thing is certain: the Comet will have little competition at Hong Kong from other jet aircraft for some considerable time to come.

On the outward leg of the first proving flight, the longest sector was between Hong Kong and Tokyo (1,710 n. miles), and the take-off weight of 67,000 kg., including 26,500 kg. of fuel, therefore the heaviest of the trip. Alternates were Misawa and Nagoya, for which 2,050 kg. of fuel, plus holding reserve, were carried, but the outward flight along this sector is made considerably easier than the return by the very strong south-westerly prevailing winds.

During our flight at 39,000 ft. these winds increased our airspeed of 415 knots to a ground speed of nearly 490 knots, but on the return trip it is sometimes necessary for the Britannias at present employed on the schedules to put in to Okinawa to refuel.

Another, and rather different, hazard on this sector, which is routed via the Chinese Nationalist island of Formosa, is the frequent ordeal of visual identification by the zealous pilots of the Nationalist Air Force. Notwithstanding the fact that Formosa is an Air Defence Identification Zone, through which all scheduled movements are carefully flight-planned, the Chinese Sabre pilots more often than not fly alongside at varying distances to check aircraft registrations.

Military pilots are officially required to stay farther than 2,000 yd. from civil aircraft during visual identification procedures, but the F-86F which intercepted our Comet at 37,000 ft. over Formosa was obviously intrigued by this sleek target, and rode just off our starboard wing tip for several minutes. The danger in these circumstances is that the wing tips are not readily visible from the Comet cockpit, and as the pilots were unaware of the presence of the Sabre the chance of collision was considerable.

A curious feature of Haneda—Tokyo's International Airport—which has also been a large American transport base for some time, is that it has no ILS, although GCA is installed and was used for our arrival in poor visibility. It is otherwise well equipped, and will be capable of accepting the big American jets. The Comet 4, of course, offers no problem, although G-APDC attracted a great deal of attention as the first example of this mark to visit Tokyo.

One of the most revealing features of this proving flight, from a personal viewpoint, was the contrast afforded by the return, over a similar route, by a Britannia 102. Ignoring overshoots for practice purposes on the outward flight, and times for diversions, the actual flying time from London to Tokyo on the stopping service by Comet was just 22 hr., compared with 35 hr. 15 min. for the longer-legged Britannia schedule. Compared with the maximum sector time (Tokyo-Hong Kong) of nearly 8 hr. for the Britannia, the longest Comet leg (same sector, reverse direction) was only 3½ hr. for overhead times, and the complete Comet flying schedule, including overshoots and diversions, was only 29 hr. 48 min.

It is slightly unfair to compare the eastbound times for the Comet with the westbound schedules for the Britannia, in view of the prevailing westerly winds, but, in general, the time taken for equivalent sectors will be reduced by about one-quarter from April onwards. The large cabin of the Britannia offers as comfortable and quiet a ride as any aeroplane, although nothing could be quieter than the front cabin of the Comet, but the higher operating altitudes of the jet result in a more turbulence-free ride.

The flexibility of the Comet will enable similarly long sectors to those flown by the Britannia to be operated on some "fast" services, and equivalent elapsed times on the eastbound flights will be something like 30 hours instead of the present 40 hours between London and Tokyo.

EMPHASIS ON MOBILITY

Nowadays changes in strategical concept, the type of defence required, and the very nature and direction of any hostile threat, occur with bewildering rapidity. Deployments undertaken at enormous cost are found to be no longer required. Defences need re-siting. The exact location of static sites becomes common-knowledge. Formations and units in the field need defending.

TO ALL THESE PROBLEMS, THE ANSWER IS

THE 'ENGLISH ELECTRIC' THUNDERBIRD

The ENGLISH ELECTRIC 'Thunderbird', now in production, is a completely mobile ground-to-air weapon system. Its mobility provides the flexibility which is becoming of ever increasing importance in future air defence . . . . **AND THE ECONOMY AS WELL.**

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

GW21A

ROTOL PROPELLERS AND EQUIPMENT
on Viscount Aircraft

SUPERMARINE SCIMITAR

Development of a Versatile Naval Aircraft

Photograph copyright "The Aeroplane"

LATEST of a long line of famous Supermarine aircraft, the Scimitar is now serving the Royal Navy in a versatile range of rôles as a low-level strike, reconnaissance and interceptor aircraft. It is the Navy's first twin-jet swept-wing aircraft and will be followed into service by others of this type, the de Havilland Sea Vixen and the Blackburn NA.39. As such it has introduced new performance standards and its near-sonic cruising speed at low level can probably be rivalled by few aircraft in the World, either sea- or land-based. No Mach-number limitations apply to it and, although the Scimitar is not supersonic in level flight, it has been dived at very high indicated airspeeds. Its ability to fly very fast at low level, and thus at very high indicated speeds, is an outstanding characteristic of the aircraft, which can deliver nuclear attacks.

The ancestry of the Scimitar was described in THE AEROPLANE of July 26, 1957, and will not be covered in detail here. Suffice it to say that its direct forebears can be traced back to 1945 when there was interest in the development of an undercarriageless naval fighter; this was to have been catapulted from an aircraft carrier and landed on an air-cushion or "flexible flight deck."

Supermarines submitted their Type 505 design for operation in this way. It was a mid-wing monoplane—with an unswept tapered wing, 7% thick and of comparatively low aspect ratio—powered by two 6,500-lb. thrust Rolls-Royce axial turbojets mounted side-by-side in the fuselage. It had a "butterfly" or V-type tail. Size and weight were restricted by the aircraft-carrier requirements of the day, which limited the overall length to 47 ft. 6 in., the folded width and height to 27 ft. and 14 ft. respectively, and the weight to 20,000 lb.

In the summer of 1946 this project was discussed with the Admiralty and the Air Ministry when it was decided that it was impractical to omit the undercarriage. New proposals were submitted for a conventional version of the aircraft. This was also redesigned to meet more stringent endurance and combat requirements.

A contract was placed for three prototypes of this later aircraft, the Supermarine 508; the official specification was issued in September, 1947. In effect, the 508 was a scaled-up version of the 1945 design with a nosewheel undercarriage; weight and wing area were increased, but the overall dimensions remained the same.

In June, 1949, Supermarines submitted a swept-wing version of the design which was based on design experience with the Supermarine 510, the swept-wing development of the Attacker which first flew at the end of 1948. This new swept-wing project became the Type 525 and a contract was received for the third prototype of the unswept Type 508 to be converted into a Type 525.

Early in 1951 a contract was received for two prototypes of a later development, the N.113. This was the aircraft which in due course came to be named the Scimitar. A production order was placed in December, 1952.

Meanwhile, in August, 1951, the Supermarine 508 had made its first flight. The prototype 525 first flew in April, 1954, and the first N.113 flew in January, 1956. Many of the developments introduced for the 525, such as its blown flaps, were embodied in the Scimitar after the original conception of the N.113 had been decided in 1951.

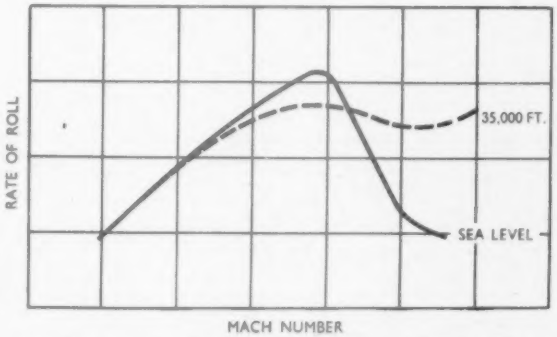
This account of Scimitar evolution will be confined to the more interesting aspects of design and development, which have been greatly affected by the gradual change of emphasis in the aircraft's Service rôle. Although originally conceived mainly as a fighter, its application as a low-level strike aircraft has come to be the dominant one.

With emphasis on under-the-radar attack using the LABS technique, the designers were faced with ensuring excellent control characteristics at very high indicated speeds. An airframe structure was also needed with an acceptable life despite the pounding it would receive both in manœuvres and from air gusts during low-level missions. This was no easy problem to solve.

Aerodynamic Problems

One of the main problems was to ensure good lateral-control characteristics over the wide range of speeds at which the aircraft was to operate. The area of the ailerons was decided by the minimum rate of roll needed at low speeds during the approach, when ailerons tend to be ineffective. But the ailerons also became less effective at high indicated speeds because of aeroelastic effects; aileron loads tend to twist the wing in the opposite direction. Thus aileron size was largely decided by aileron effectiveness at high and low speeds. As a result, at speeds between these, the ailerons were exceptionally sensitive and could produce an excessive rate of roll, as the diagram below indicates.

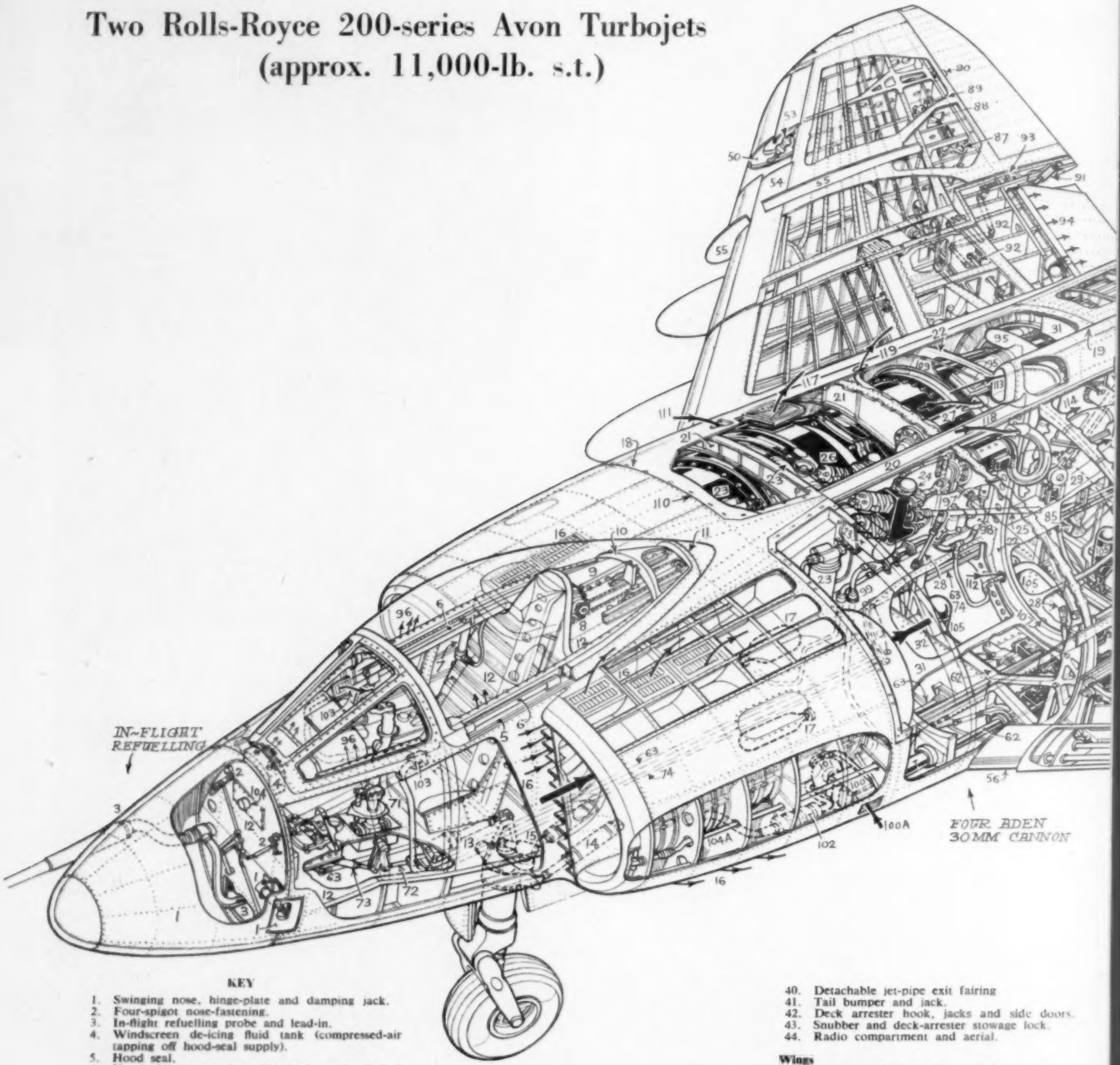
(*Continued on page 220*)



LATERAL CONTROL.—The variation of rate of roll with Mach number is indicated for a high-speed aircraft. Aeroelastic effects produce a marked falling-off in lateral-control effectiveness at the high indicated airspeeds of low-level, high Mach-number flight.

THE SUPERMARINE SCIMITAR F.1

Two Rolls-Royce 200-series Avon Turbojets (approx. 11,000-lb. s.t.)

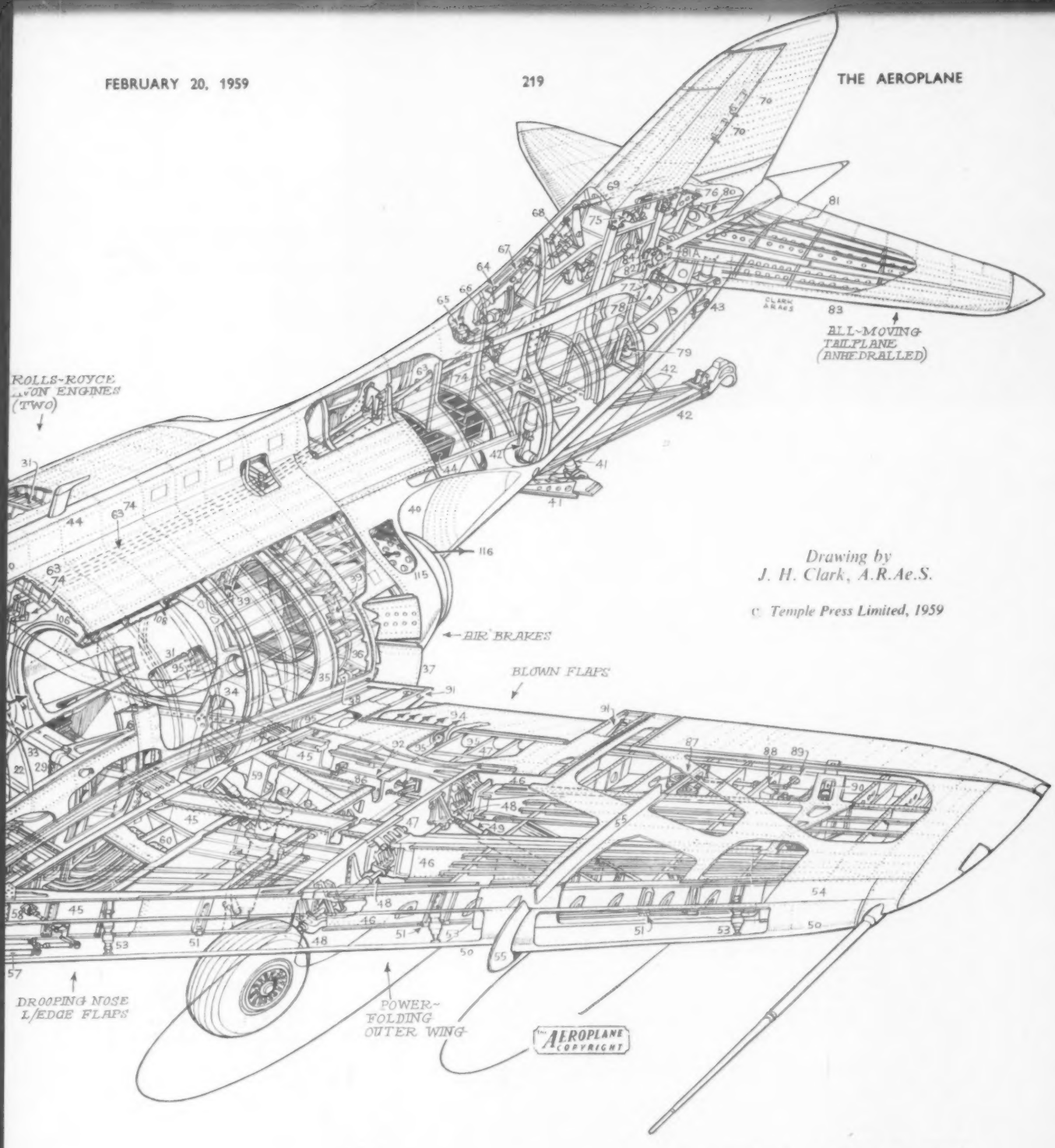


KEY

1. Swinging nose, hinge-plate and damping jack.
2. Four-spigot nose-fastening.
3. In-flight refuelling probe and lead-in.
4. Windscreen de-icing fluid tank (compressed-air tapping off hood-seal supply).
5. Hood seal.
6. Hood-sliding trough with jettison (explosive) charge 7.
8. Hood-retraction motor and chain drive and guide-rails 9 (drive taken up into floor 10).
11. Hood jettison hinge.
12. Pressurized-cockpit front and rear bulkheads and floor.
13. Backward-retracting nosewheel (operating jack 13, lock struts 14, centring jack 15).
16. Boundary-layer bleed.
17. Oxygen bottles (each side).
18 along to 19. Engine bay each side of a central diaphragm (structural and firewall) 20 and detachable half-frames 21 and firewall-frame 22.
23. Hydraulic fluid filter and reservoir (each side).
24. Auxiliaries gearbox with drive (25) off engine (each side) carrying hydraulic pumps 26 and with shaft drive through to generator 27.
28. Engine front pick-ups.
29. Engine main pick-ups and overload strut 30.
31. Fireproof flooring to engine bays from underfloor compartments, and along jet-pipe tunnel.
32. Wing front-spar pick-up half-frame with attachable top-half.
33. Wing main-spar pick-up frame.
34. Wing rear-spar pick-up frame.
35. Frame carrying fuselage flaps (in line with wing flaps) and launching hooks under side.
36. Frame carrying three air-brakes (37) each side.
38. Air-brake operating jacks (hydraulic).
39. Inner and outer jet-pipe rear supports (both provide vertical adjustment—outer hinged for lateral expansion).
40. Detachable jet-pipe exit fairing.
41. Tail bumper and jack.
42. Deck arrester hook, jacks and side doors.
43. Snubber and deck-arrester stowage lock.
44. Radio compartment and aerial.

Wings

45. Three root-fixings with spars (inner wing).
46. Three-spar outer wing (folding) hinged on main and rear spar at top joint 47.
48. Bottom joint (front, main and rear) with hydraulic sliding locking pins.
49. Wing-fold jack anchored in outer wing.
50. Drooping leading-edge sections hinged at 51 all along front spars, and with operating jacks 53.
52. Not used.
54. Normal-camber top (fixed) surface piece.
55. Fixed and droop fences.
56. Sideways-moving piece with linkage 57 anchoring at 58 (forward droop requires inboard sideways movement of 56 to close the gap with fuselage).
59. Heavy-section member for undercarriage pick-up.
60. Gun magazines.
61. Not used.
62. Underfloor Aden guns (two each side).



Drawing by J. H. Clark, A.R.Ae.S.

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Flying Controls

Rudder

63. From rudder pedals through linkage 63 to artificial-feel mechanism 64, including feel-simulator unit 65, trim actuator 66, feel-simulator jack 67, booster 68, rod 69.
70. Oil-filled dampers.

Tailplane

71. From stick 71 out through pressure gland on to linkage and feel-simulator jacks 72 and trim actuator 73; thence via linkage 74, flap and tail-plane auto-trim actuator 75, linkage 76, to tailplane-actuator valve 77.
78. Tailplane actuator anchored at 79 and picking up crosshead 80 between root-ribs 81 of tailplane halves.
81A. Coupler between starboard and port tailplane main-spars.
82. Hinge-point of ribs 81 for tailplane incidence-change.
83. Anhedral tailplane.
84. Cable interconnection to wing flaps.

Ailerons

From stick 71 out through pressure gland thence via linkage 85 (see by main-spar frame) changing into cables out to wings at 86.
87. Cable tensioner.
88. Control-valve mechanism with follow-up rod 89 and operating jack 90.

Flaps

91. Operating jacks controlled by electric actuator 75 (see tailplane circuit, underneath fin), cables 84, rods 92 and control-valve mechanism 93.
94. Compressed air from engine combustion-air tapping through trunks 95 (fuselage and leading-edge flaps operated in due turn by same actuator 75).

Air Conditioning System

96. Cockpit hood and windscreen interspace demisting (from starboard engine 8th-stage tapping).
97. Air from engine (repeat on starboard side) to distribution box 98 (complete ring through vertical wall). Thence via 99 to port heat exchanger 100 (with its cooling air 100A), cold-air unit 101, starboard secondary heat exchanger, water extractor 102, thence to diffusers 103 in cockpit.
104. Outward relief valve. Tappings are taken for anti-g suit, hood seals (5), and radio compartment aft (at 44).
104A. Air-intake anti-icing (tapping off engines' gate valve).

Fire Services

105. (Three) bottles.
106. Spray ring (for Zone 2).
107. Two discharge nozzles (for Zone 2) and one in front of Zone 1.
108. Graviner Firewire in each jet-pipe tunnel.
109. Graviner Firewire on (each) firewall 22

Fire Zones and Other Cooling

Zone 1: 110 to firewall 22.
Zone 2: 22 to jet-pipe exit.
111. Zone 1 air inlet.
112. Zone 1 outlet (tapping off 98 into 112 gives venturi effect and therefore circulation in ground-running).
113. Zone 2 air inlet (to each side) via manifolds 114. Thence along tunnel, into jet-pipe double skin at 115 and out at 116.
117. Compressor-bleed outlets.
118. Generator cooling-air inlets and outlets 119.

NEEDLE-NOSED N.113.—The N.113—in effect the Scimitar prototype—first flew in January 1956.

(*Continued rom page 217*)

This problem arose with the Scimitar; at moderately high Mach number the rate of roll was very high. With the original power controls the lateral control was too sensitive and pilots found they were continually over-correcting.

To solve this problem the characteristics of the power-control system needed a much higher degree of accuracy than had been achieved before. Two solutions were adopted: the break-out force required at the control column to begin an aileron movement was reduced to ¾ lb. by fitting a small power-control jack in the circuit close to the control column, and changes were also made in the valve system of the tandem-jack aileron power controls to ensure low operating loads. A variable-gearing device was also introduced so that control-column movement was doubled for the first degree of aileron deflection.

With this redesign it was found that the minimum angular deflection of the ailerons which the pilot could make was reduced to 0.03°. This change gave pilots much more accurate lateral control at high speeds.

Pitch-up Problems

Longitudinal control problems were also met and solved in th development of the Scimitar. Its mid-wing configuration, with the tailplane set higher than the wing to avoid the jet efflux, is a bad one for avoiding high-speed pitch-up and consequent tightening in turns. For this reason many current fighters have low-set tailplanes.

Flight tests with the Supermarine 525 had shown that a slight, but acceptable, pitch-up occurred. Early tests with the Scimitar indicated that the pitch-up was worse. It was caused by shock-induced separation leading to high-speed tip-stall of the wing. As a result the centre of pressure moved forward, giving a pitch-up effect, which was made worse by an increase in the downwash over the tailplane. The worst pitch-up occurred at high altitude at high Mach numbers.

Investigations with the Swift and the Supermarine 525 had shown the advantage of a saw-tooth leading edge in curing pitch-up difficulties. This was installed on the Scimitar together with wing fences whose value had been shown by flight tests. But the greatest improvement was produced by changing the tailplane from one having a 10° dihedral to one with 10° anhedral; this lowered the tips by 3 ft. This was not included in the original design because it increased the structural effect of jet noise on the tailplane—a problem that is discussed later—in this article.

The Scimitar has duplicated power controls on the ailerons and its slab tailplane, and unduplicated power control with manual reversion on the rudder. There is spring feel on the ailerons and the Hobson feel system (which in effect combines q-feel with additional spring feel) on the tailplane and rudder. Longitudinal control forces are low—about 2-3 lb. per *g*.

Tailplane and flaps are coupled so that there is a 4° trimming deflection of the tailplane when the flaps are lowered. There is no variable gearing of the tailplane dependent on airspeed, but a non-linear linkage is used so that towards the extreme of tailplane deflection the deflection rate for unit movement of the control column is four times that obtained with initial movement of the column from its central position.

The Blown-flap System

An interesting feature of the Scimitar is its blown-flap system which was introduced to reduce the aircraft's approach speed and improve its controllability for deck landing. The system used was described in some detail in THE AEROPLANE of January 18, 1957.

Air is tapped from each of the Scimitar's Avon engines and ducted to long narrow blowing nozzles along the upper surface of the flaps. Air emerges at supersonic speed in a thin sheet which energizes the boundary layer on the upper surface of the flaps and prevents the flow breaking away.

Some 5% of the engine mass flow is ducted to the flaps when they are in the landing position. But despite the reduction in engine thrust this produces, it is possible for the Scimitar to make an overshoot with full "blow" on.

Inertia Coupling

During the development of the Scimitar, a thorough study was made of the problems of roll-yaw inertia coupling—which had been highlighted by a series of accidents to Super Sabres in the U.S. The problem has become important with modern aircraft which tend to have most of their weight concentrated in lengthy fuselages and have relatively low-weight short-span wings. With a configuration of this sort, inertia forces during a roll can produce an excessive yaw which is structurally fatal to the aircraft.

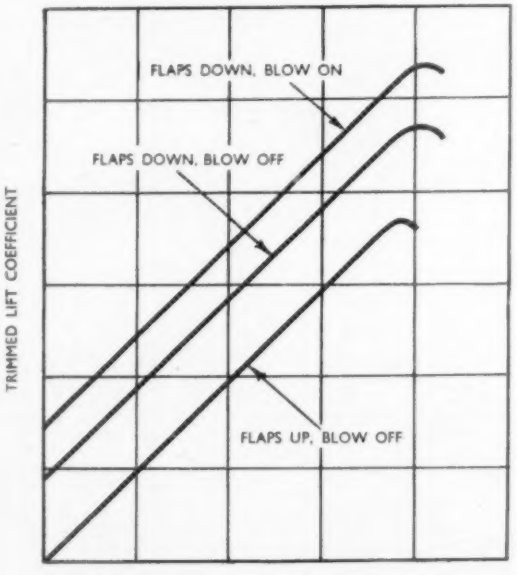
Supermarine made a thorough investigation of the problem as it affected the Scimitar on both analogue and digital electronic computers. The results showed that critical angles of sideslip might be produced which would overload the fin and rear fuselage. Structural tests, however, showed that their strengths were adequate and the aircraft now has an almost unrestricted clearance for manœuvres.

This computer study showed that the worst inertia-coupling cases arose in a rolling pull-out. In flight tests to check this, rapid 180° rolls were made with 6*g* applied to the aircraft.

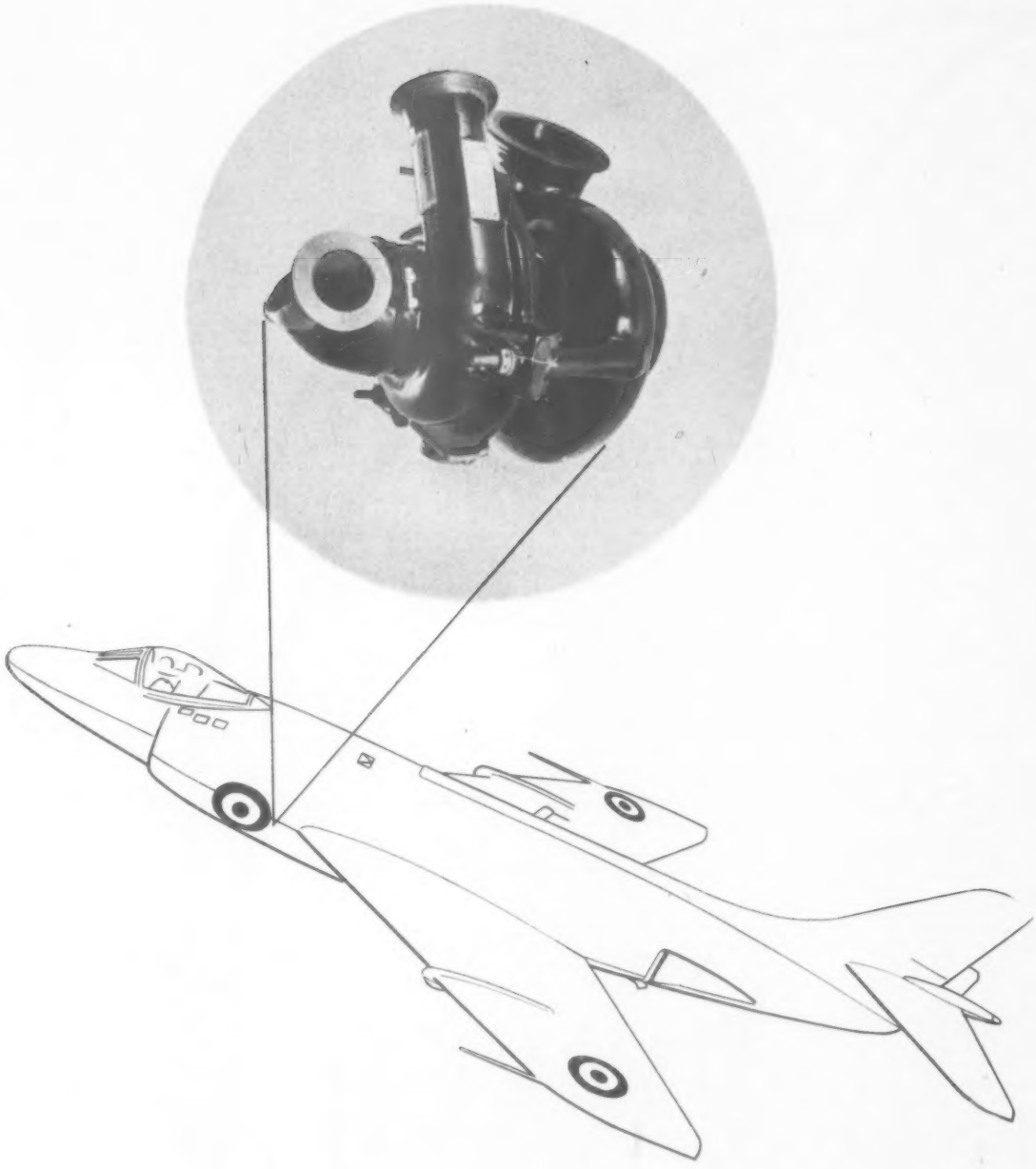
Body Shaping

Although the waisted shape of the Scimitar suggests that Area Rule was applied in its design, this was not so. The

(*Continued on page 221*)



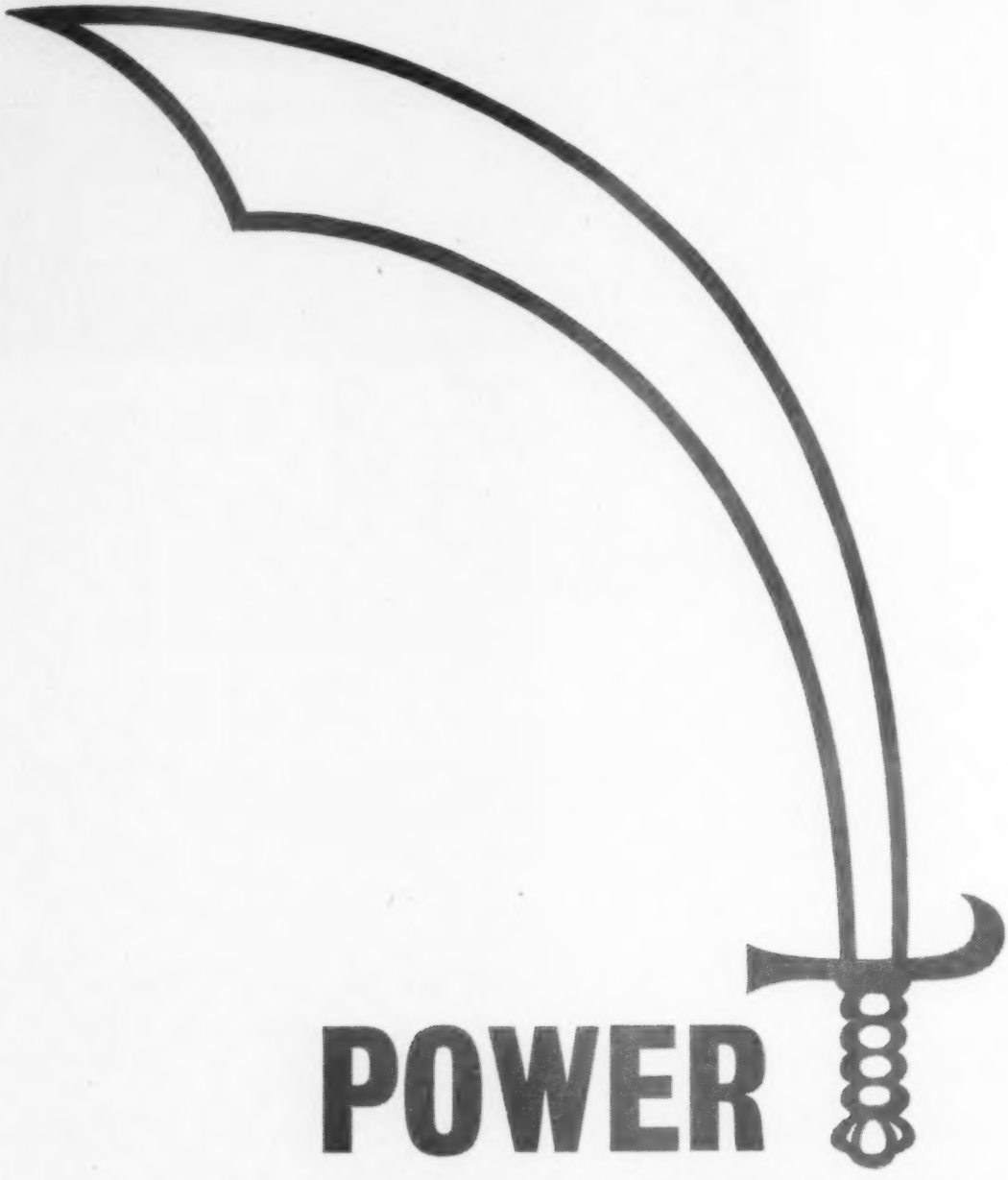
BLOWN FLAPS.—The extent to which blown flaps can increase the lift coefficient of an aircraft is indicated in this diagram. They can reduce the approach speed by about 10%.



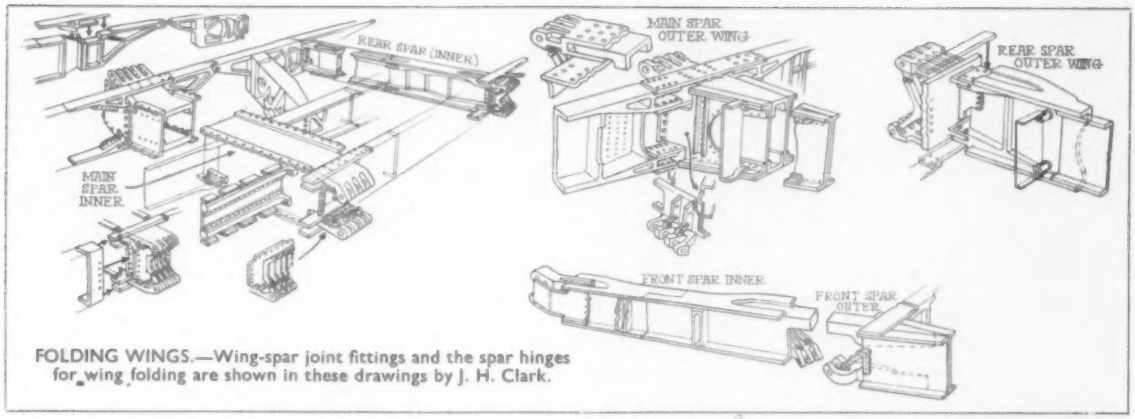
The heart of the Scimitar's air-conditioning system

—a de Havilland cold-air unit.

DE HAVILLAND PROPELLERS LTD



POWER CONTROLS by FAIREY



FOLDING WINGS.—Wing-spar joint fittings and the spar hinges for wing folding are shown in these drawings by J. H. Clark.

(*Continued from page 220*)

shaping of the wing-body junction was chosen to delay the drag rise by minimizing peak suctions and by maintaining the sweepback of the pressure isobars over the wings. The Kücheman wing-tip shape was chosen also to maintain isobar sweepback at the tips.

Another interesting aspect of Scimitar flight trials was the spinning tests which were made. Thorough precautions were taken—the flight-instrument readings of the test aircraft were telemetered using R.A.E. equipment to a ground set-up where a check pilot watched them so that he could advise the airborne pilot if he was in difficulties. A chase aircraft also kept the test Scimitar under observation.

Before full-scale flight trials began, tests were made by the R.A.E., Bedford, with spinning models dropped from a free balloon. These indicated that there would be no difficulty in recovering from a spin—and so it proved in the full-scale tests. A great deal of height was lost, however, before recovery was complete—a characteristic of modern highly loaded fighters.

Structural Development

The structure of the Scimitar is on conventional stressed-skin lines. Its most interesting features are the use of titanium, chemically etched skins and integral frames. On the development side, the main problems have been the structural effects of engine noise and the fatigue testing necessary to produce a structure which would withstand at least 1,000 hours of high-speed, low-level operation.

About 270 lb. of titanium are used in the airframe of each Scimitar. One of the most important applications is in the air ducts for flap blowing. Other uses are for blast plating near the ports of the four 30-mm. Aden cannon, for the cannon blast tubes, for part of the jet-exit fairing, and for heat shielding.

It is only used in low-strength applications and the only drawback shown up by Supermarine experience has been the relatively poor resistance of titanium to fluctuating stresses. This has meant that special care has had to be taken in design.

Chemical etching of aerofoil and fuselage skins is used to a large extent on the Scimitar. In this process the skins are uniformly coated with a resistant film. Templates are then laid over the skins, which are scribed, and the resistant film is stripped from the areas whose thickness is to be reduced. The skins are then lowered into a caustic soda bath where the unprotected surfaces are dissolved gradually; the sheets are removed after a set time which depends on the amount of metal to be removed.

This process is rapid, versatile and cheap. It is much faster than if the skins were to be milled in a conventional fashion and the plant required is much cheaper. It also lends itself readily to production changes; for example, skin cracking during Scimitar flight tests showed that thicker aerofoil skins were needed. These were easily provided by reducing the time the skins were immersed in the chemical-etching bath.

Extensive use is made in the Scimitar airframe of integral frames which are milled from high-strength light alloy. The aircraft also has high-tensile steel members in its wing and tailplane and in this respect it has set the fashion for another low-level naval aircraft, the Blackburn NA.39.

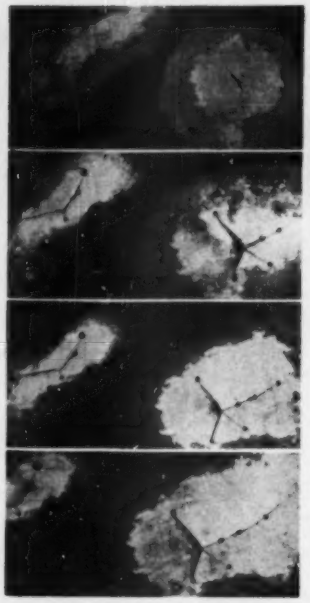
Effects of Noise

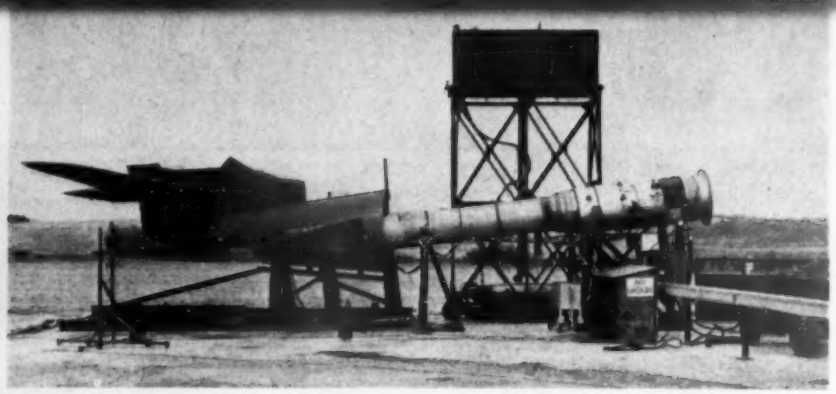
Engine noise has had an important and adverse affect on the structure of the Scimitar. The problem was shown up during the first test runs of a rig consisting of a part of the fuselage incorporating the pen-nib fairings designed to deflect the engine jet-stream outwards. This fairing, originally constructed of 20 s.w.g. (0.036 in.) Nilo K sheet, cracked after only 40 minutes of engine running.

As a result of this test, a further noise-test rig was built, consisting of a Scimitar rear fuselage and tailplane with one Avon engine installed in it. So far as the pen-nib fairings were concerned tests were made working towards thinner gauges from 10 s.w.g. (0.128 in.) mild steel. The fairing finally proved satisfactory was a stiffened one of 16 s.w.g. (0.064 in.) mild steel sheet. This was cleared for 800 flying hours by testing it on the ground for 80 hr.; a 10 to 1 factor was assumed because the effect of engine noise is only serious during ground running.

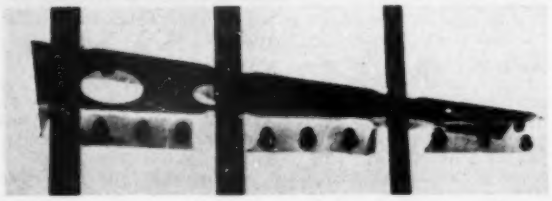
During these tests it was shown that noise damage was also caused to the rear fuselage and to the tailplane, which had been placed at 10° anhedral angle as an anti-pitch-up measure, as mentioned earlier. With the original tailplane, very bad cracking

TWO-VIEW.—The pilot's head gives scale to this photograph and indicates how large an aircraft the Scimitar is. These Scimitars are from No. 807 Squadron based at R.N.A.S. Lossiemouth.





NOISE-TEST RIG.—Extensive tests were made with this rig to study the damage which might be caused by engine noise to the Scimitar's rear fuselage and tail unit during ground running of its Avon engines. The photographs on the left show that panel cracking caused by engine noise cannot be limited in the usual way by drilling "crack-stopper" holes. The panel is shown after engine running times of 4¾, 14¼, 17¼ and 17¾ hr. respectively.



RIB CRACKING.—This X-ray of a light-alloy trailing-edge rib shows the cracking produced by 20¼ hr. of engine running in the test rig.

was found after only 20 hours of engine running, and the drilling of holes at the end of the cracks was completely ineffective in preventing these cracks spreading.

The tailplane was redesigned to avoid these difficulties; thicker skins were used, light-alloy ribs were replaced by steel ones, larger rivets were used and skin joints were synthetic-resin bonded to prevent fretting. Foam filling was also used to stabilize the skins in certain areas.

Cracking is still caused by engine noise. But static tests have shown that the strength of the structure is acceptable with a considerable amount of noise-induced cracking present.

An interesting conclusion from the tests is that even steel ribs can eventually crack, despite the belief that steel will withstand an infinite number of load reversals if a stress less than the fatigue limit is applied. The stresses caused by engine noise are only ±1·2 tons/sq. in., but the frequency is very high.

Similar skin cracking has been experienced in Scimitar flight tests; this was caused by aerodynamic vibration. The solution was to use thicker skins and to stabilize them with a foam filling.

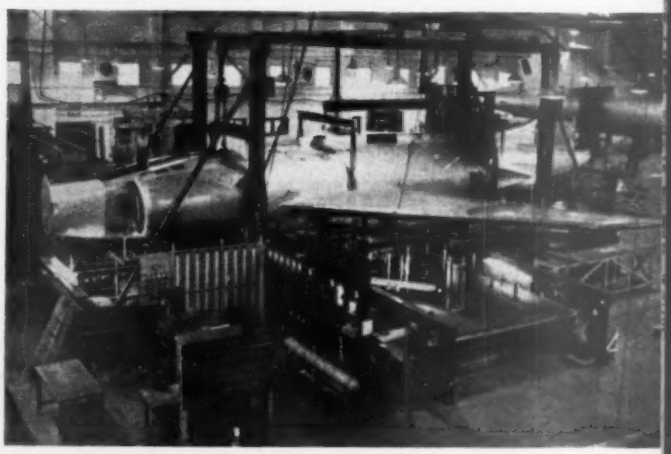
In designing the Scimitar airframe the aim has been to achieve a fatigue life of at least 1,000 hr. A complete airframe is at present on test; its load programme simulates the gust and manœuvre loads of a typical low-level sortie. A scatter factor of 5 is used and the aim is thus to test the aircraft to 5,000 hr.

Much space would be needed to describe the airframe systems of the Scimitar in any detail, but two points are worthy of special mention. They are its hydraulic system—the Scimitar is said to be the first military aircraft with a 4,000-p.s.i. system—and its fuel system, which has both electronic and mechanical fuel proportioning. The fuel system also incorporates a retractable probe for air-to-air refuelling.

Future Development

Versatility and striking power is the keynote of the Scimitar. In all its rôles it can rely on four 30-mm. Aden cannon. In addition, as a fighter it can carry 48 unguided air-to-air rockets. With a camera nose to its fuselage it becomes a reconnaissance aircraft. As a strike aircraft it carries a vast variety of stores beneath its wing in addition to drop tanks; these include various types of rocket projectile, mines and 500-lb. or 1,000-lb. bombs of various types, and the tactical atomic weapon.

Because of the versatility of its current performance, the Scimitar offers considerable scope for further development, both as a fighter and a strike aircraft. No doubt during the course of the long Service life which lies before it, it will be called upon to fulfil tasks that were not envisaged when the aircraft was first developed. And doubtless, too, the Supermarine team will succeed in "stretching" their creation to the utmost.—J.B.C.



HARD-WORKED AIRFRAME.—Repeated loading cycles have been applied to this fatigue-test Scimitar; they represent a typical low-level sortie. The test is intended to prove that the airframe has a low-level fatigue life of at least 1,000 hr.

SCIMITAR SUPPLIERS

This list of Scimitar suppliers has been given by Vickers-Armstrongs (Aircraft), Ltd.—

Amphenol (Great Britain), Ltd.; George Angus and Co., Ltd. (Oil Seal Division); Appleby and Ireland, Ltd.; Auster Aircraft, Ltd.; Auto Klean Strainers, Ltd.; Automotive Products Co., Ltd.; A.V.A., Ltd.; Aviation Developments, Ltd.; Avica Equipment, Ltd.

Belling and Lee, Ltd.; Bowden (Engineers), Ltd.; J. R. Bramah and Co., Ltd.; Bristol Aeroplane Co., Ltd.; British Electric Resistance Co., Ltd.; British Insulated Callender's Cables, Ltd.; British Thomson-Houston Co., Ltd.; Brush Electrical Engineering Co., Ltd.; Burgess Products Co., Ltd., (Micro Switch Division).

Cannon Electric (Great Britain), Ltd.; Clang, Ltd.

de Havilland Propellers, Ltd.; Dowty Equipment, Ltd.; Dubilier Condenser Co., Ltd.; Dunlop Rubber Co., Ltd.; Dzus Fastener (Europe), Ltd.

H. W. Edghill and Co., Ltd.; Electro-Hydraulics, Ltd.; Electronic Components; Engel and Gibbs, Ltd.; Ericsson Telephones, Ltd.; Erie Resistor Co., Ltd.; Erma, Ltd.

Fairey Aviation Co., Ltd.; Feeny and Johnson, Ltd.; Films and Equipments, Ltd.; Fireproof Tanks, Ltd.; Firth Cleveland Instruments, Ltd.; Flight Refuelling, Ltd.; A. Frazer-Nash, Esq., M.I.M.E.

Gardners Radio, Ltd.; General Electric Co., Ltd.; Girling, Ltd.; Gloster Aircraft Co., Ltd.; Sir George Godfrey and Partners, Ltd.; Graviner Manufacturing Co., Ltd.

Hellermann, Ltd.; Hendrey Relays, Ltd.; Heston Aircraft and Associated Engineers, Ltd.; H. M. Hobson, Ltd.; Hoffmann Manufacturing Co., Ltd.; A. H. Hunt (Capacitors), Ltd.; Hymatic Engineering Co., Ltd. Integral, Ltd.

Kelvin and Hughes (Industrial), Ltd.; King Aircraft Corporation.

Manganese, Bronze and Brass Co., Ltd.; Marconi's Wireless Telegraph Co., Ltd.; Marston Excelsior, Ltd.; Martin-Baker Aircraft Co., Ltd.; M. B. Metals, Ltd.; F. G. Miles, Ltd.; M. L. Aviation Co., Ltd.; Morfax, Ltd.; Morris Motors, Ltd., (Radiator Branch).

Normalair, Ltd.; N.S.F., Ltd.

Oddie, Bradbury and Cull, Ltd.; John Compton Organ, Ltd.

Page Engineering Co.; Painton and Co., Ltd.; Paton and Co., Ltd.; Plessey Co., Ltd.; Pulsometer Engineering Co., Ltd.; Pye, Ltd.

Radium Light Co., Ltd.; Ransome and Marles Bearing Co., Ltd.; Rist's Wires and Cables, Ltd.; Rolls-Royce, Ltd.; Ross, Ltd.; Rotax, Ltd.; Rotol, Ltd.

Sangamo Weston, Ltd.; Saunders-Roe, Ltd.; Saunders Valve Co., Ltd.; Siemens-Ediswan, Ltd.; Silentbloc, Ltd.; Simmonds Aerocessories, Ltd.; Skefko Ball Bearing Co., Ltd.; Smiths Aircraft Instruments, Ltd.; S.P.E. Co., Ltd.; Standard Telephones and Cables, Ltd.; Superflexit, Ltd.

Tecalemit, Ltd.; Teddington Aircraft Controls, Ltd.; Teleflex Products, Ltd.; Thermal Control Co., Ltd.; Thorn Electrical Industries, Ltd.; George Tucker Eyelet Co., Ltd.; Turner and Savage, Ltd.

Vandervell Products, Ltd.; Vickers-Armstrongs (Aircraft), Ltd.; W. Vinten, Ltd.

Ward and Goldstone, Ltd.; A. Wells and Co., Ltd.; Welwyn Electrical Laboratories, Ltd.; Western Manufacturing (Reading), Ltd.; Westinghouse Brake and Signal Co., Ltd.; Wilmot Breeden, Ltd.; J. S. White and Co., Ltd.; Woodwards Springs, Ltd.

The Fighting Services

Senior R.A.F. Appointments

NEW posts for four senior R.A.F. officers have been announced. Air Chief Marshal Sir Harry Broadhurst, K.B.E., D.S.O., D.F.C., A.F.C., A.O.C.-in-C., Bomber Command, is to become Commander, Allied Air Forces Central Europe, in May, in succession to Air Chief Marshal Sir George Mills, G.C.B., D.F.C. The latter having been appointed to succeed Admiral Sir Michael Denney in July as chairman of the British Joint Services Mission in Washington.

Following these two changes, Air Vice-Marshal K. B. B. Cross, C.B., C.B.E., D.S.O., D.F.C., will succeed Air Chief Marshal Sir Harry Broadhurst as A.O.C.-in-C., Bomber Command, on May 17 with the acting rank of Air Marshal, and Air Vice-Marshal M. H. Dwyer, C.B.E., will become A.O.C., No. 3 Group, Bomber Command on May 11, in succession to Air Vice-Marshal Cross.

Runway Barrier Results

AIRCRAFT crash-barriers installed at the end of runways have now been under test at 2nd T.A.F. airfields in Germany for a year. Six months ago reports from R.A.F. Ahlhorn (THE AEROPLANE of April 18, 1958), where the first models of the Swedish-built Safeland barrier were tested, indicated that the device was of practical use and earlier this year SHAPE announced that all NATO airfields would soon be equipped with them.

Its effectiveness was clearly demonstrated at Ahlhorn, and at R.A.F. Gutersloh in the past six months, when two barriers, one at either end of the runway, have been proved five times under the supreme test—the actual halting of runaway aircraft.

Three "operational engagements," as they are called, took place at Gutersloh in September and October, 1958, when there was one barrier operating. In the first a pilot had to abandon his take-off well down the runway while travelling at 100 knots. He warned ATC, the barrier was raised and the aircraft engaged and brought to a stop. But for the barrier it would have gone through the perimeter wire into a river. The second engagement also occurred after an abandoned take-off. The third aircraft suffered brake failure on landing.

Last month a Hunter and a Swift at Gutersloh were arrested within ¾-hr. by two barriers, a second by then having been installed at the other end of the runway, while landing with a strong crosswind and very wet runway surface. None of the five aircraft suffered much damage.

A report from Headquarters, 2nd T.A.F., has stated that by saving the first three aircraft from major damage the initial barrier at Gutersloh alone had already more than paid for the cost of installing barriers at each of the remaining airfields in the Command. The Gutersloh barrier is a four-ton model, suitable for Hunters, Vampires, Meteors and Swifts, and of practical value in minimizing the length of overshoots for Canberras and Javelins. An improved version specially designed for arresting swept-wing jet aircraft of the Hunter class has been installed at the R.A.F. stations at Sylt and Jever.

IN THE NEWS.—Left, Air Chief Marshal Sir Harry Broadhurst, who, as announced opposite, is to become Commander, Allied Air Forces Central Europe, in May. Right, Air Marshal Sir Harold Jackman, A.O.C.-in-C., Maintenance Command, seen after the investiture at Buckingham Palace on February 10 when he received his K.B.E.

R.A.F. Manpower and Recruiting

FROM a personnel viewpoint one of the more interesting facts given in the Ministry of Defence's recently published White Paper, "Progress of the Five-Year Defence Plan," is that the R.A.F. has completed two-thirds of its planned run-down. This has been made possible partly by some reduction in the number of squadrons, but principally by economies in the administrative organization and training establishments.

On April 1, 1958, the Service was made up of 140,700 regulars, 45,600 National Service personnel and 4,700 W.R.A.F., giving a total strength of 191,000. The estimated figures for April 1 of this year are 142,300, 26,300, 4,800 and 173,400 respectively. During 1958 the R.A.F. obtained 13,000 recruits on engagements of five years or more, compared with 9,000 in 1957, so that the Service's all-regular ceiling of 135,000 personnel in 1962 should be reached quite comfortably.

Entries of officer cadets into Cranwell and Henlow are stated to be reasonably satisfactory, but entries of aircrew, on direct and short-service commissions, are still appreciably below requirements. This, the White Paper states, may in part be due to the impression that, with the advent of the rocket, aircraft will have little part to play. That is, of course, wrong.

The main points from the White Paper and the Defence Statistics were reported in THE AEROPLANE for February 13.

NEW WORLD VISIT.—Air Vice-Marshal J. G. Davis, S.A.S.O., Bomber Command (left), seen with Gp. Capt. D. D. Haig, O.C., R.A.F. Finningley (centre) and Sqn. Ldr. D. T. Skeen, aircraft captain, before his flight in a No. 101 Squadron Vulcan to Bermuda, the United States and Canada on February 10. The Vulcan was to take part in the island's 350th anniversary of colonization and A.V.M. Davis was to lecture to the U.S.A.F. War College and the R.C.A.F. Staff College before returning on February 19.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Sqn. Ldr. D. J. Bolter for duty in the Department of the C.A.S. (with acting rank of Wg. Cdr.).

Bomber Command: Wg. Cdr. J. M. Urquhart to R.A.F. Feltwell as Senior Medical Officer; Sqn. Ldr. S. W. K. Hart, O.B.E., to Headquarters for Provost duties (with acting rank of Wg. Cdr.).

Flying Training Command: Wg. Cdr. S. M. Bieber to Headquarters No. 23 Group, as Senior Medical Officer; Wg. Cdr. G. H. Dhenin, A.F.C., G.M., to the R.A.F. Staff College, Bracknell, for studies.

Technical Training Command: Wg. Cdr. J. W. McCombie, O.B.E., to Headquarters as Group Captain Training (A) (with acting rank of Gp. Capt.); Wg. Cdr. L. L. Flowerdew to Headquarters for technical staff duties; Wg. Cdr. J. E. S. Salter to No. 1 School of Technical Training, Halton, for accounts duties; Sqn. Ldr. G. Strange to R.A.F. Hereford to command the Boy Entrants Wing (with acting rank of Wg. Cdr.).

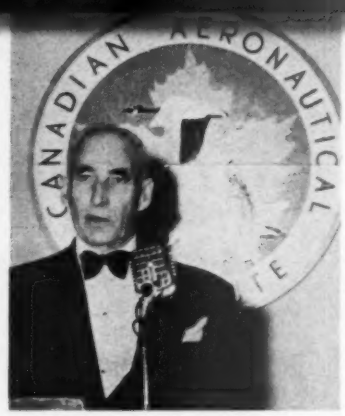
Home Command: Wg. Cdr. F. H. D. Hutter to R.A.F. Hospital, Halton, as Surgical Specialist.

R.A.F. Germany (2nd T.A.F.): Wg. Cdr. J. C. Bevan to Headquarters for technical staff duties.

Middle East Air Force: Wg. Cdr. R. E. B. Pinchard to Headquarters for administrative staff duties.

British Forces Aden Peninsula: Wg. Cdr. J. R. Gardner to Headquarters for staff duties; Wg. Cdr. M. O. Richardson to R.A.F. Hospital, Aden, to command.

The British Commonwealth's Premier Pilot



by Capt. J. Laurence Pritchard

IN an age when the stars in their sputnik courses wink wantonly at ageing Earth-bound aeroplanes, it must be fun to declare: "I was the first to fly one," and so become an immortal star in Commonwealth skies.

John A. Douglas McCurdy, a Canadian, did just that 50 years ago in Canada,

When East was East and West was West
And both of them grew much wheat.

Most small boys like kites, and if you are lucky and live almost next door to a man who flies the biggest kites in the world which actually take a man into the skies, then it is more than likely you will be bitten with the flying bug and be lost to civilization for ever and ever. John McCurdy was such a lucky small boy, for his father was secretary to Dr. Graham Bell, who experimented with kites on the shores of the Bras D'Or Lake at Baddeck, Cape Breton Island, Nova Scotia. Dr. Bell had turned to aviation after inventing that unscripted talking terror, the telephone.

So the young McCurdy went to Toronto University and graduated in 1907 as an engineer, in company with another young Canadian, F. W. ("Casey") Baldwin, a grandson of one of the founders of the Dominion of Canada. That summer McCurdy invited his friend to spend some of his holidays at Baddeck to see for himself what Dr. Bell was doing. By that time both had their heads very much in the air and were determined to get their bodies there as quickly as they knew how. Not that they knew then!

Dr. Bell, who was sixty, wanted at that moment two youngsters with knowledge of engineering and a mad enthusiasm to take a chance with something new. And here they were. In less time than it takes to record it the Aerial Experiment Association was formed with Dr. Bell as chairman, McCurdy and Baldwin as two of its engineers, Glenn Curtiss as its advisor and manufacturer (and later pilot) of engines, and Lieut. Thomas Selfridge, of the U.S. Army, to keep an eye on any developments from a non-civil point of view.

Under the unwritten rules of the A.E.A. the object was to train the members in flying "with the crude and roughly built machine at hand." Each was expected to take charge in turn of designing and building an aeroplane and of learning to fly it. A tough assignment on any grounds, but the two young engineers fresh from Toronto were so confident that they both took on the proposition as eagerly as a Duck (Canard) in later years took to flying the wrong way round.

To get the data and experience necessary, many experiments were carried out on kites, engines, propellers, gliders and materials. Each member could and did give advice to the one responsible at the time, and took no umbrage if the advice was not taken. There was also study of what others were doing, especially the Wright brothers, which led to some arguments in later years.

The first machine built was designed by Lieut. Selfridge and flown on March 12, 1908, by "Casey" Baldwin in the absence of the designer. The Red Wing rose from the hard, thick ice on Lake Keuke, near Hammondsport, where the A.E.A. had been carrying out the construction in the engine works belonging to Glenn Curtiss.

Watched by his envious fellow Torontonian, Baldwin shot across the ice "like a scared rabbit" and "rising to a height of six to eight feet, flew three hundred and eighteen feet, eleven inches."

Aircraft performance reports in those days had to be far more accurate than they are in these days of jet propulsion.

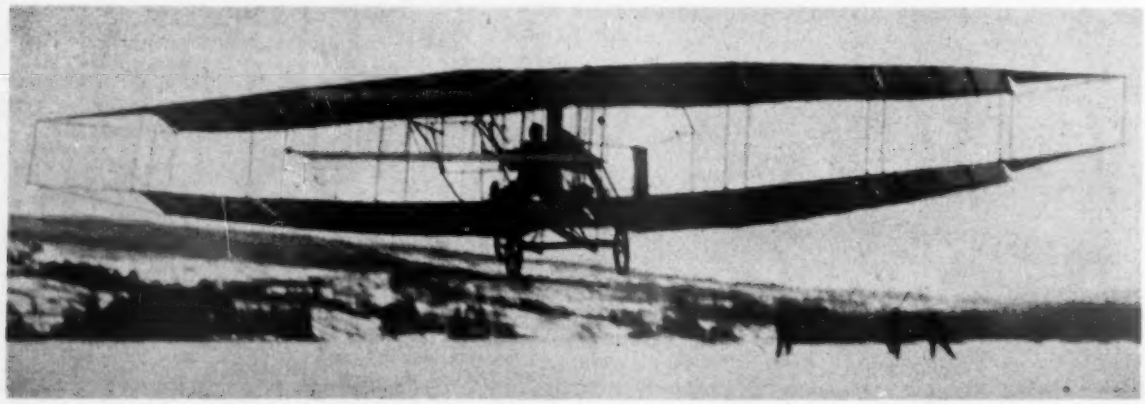
It was a frail machine, and those last few inches proved 11 plus too much, for it dropped a tired wing and the hard ice did the rest. Red Wing had taken seven weeks to build (British firms please copy) and three times seven seconds to crash (don't copy). But, and what a but it is, a young Toronto engineer had made his first flight!

McCurdy, inspired, thrilled, and crazy to do likewise, was to make the first flight ever made in any part of the Commonwealth by a British citizen in a power-driven heavier-than-air machine less than 12 months later. Aeronautical pioneers worked fast in those days, for there were two more machines designed and built before he got his chance.

Baldwin was given the honour, in view of his flight, of designing and building the second aeroplane, the White Wing. It proved to be more resistant to flying than Red Wing, but in the event, despite numerous minor mishaps on the way, it had a longer air life. For those who are still air-minded, the basic figures of Red Wing were: 385.7 sq. ft. surface area, 570 lb. all-up weight, including pilot and 40-h.p. Curtiss engine.

These two bright-eyed young engineers from Canada delighted in showing the Americans in Hammondsport what could be done with the somewhat primitive motorcycles which were being made there. Those were the days when men were men (as distinct from women, who still were women), but motorcycles were the very devil. McCurdy used to give frequent demonstrations to his fellow A.E.A. members of how to fall off a motorcycle scientifically, in between discussing the effects of propeller torque. He survived, as a result, many aircraft crashes which might have proved fatal to others.

On May 23, 1908, he made his first flight on White Wing, on



HISTORIC OCCASIONS.—The Silver Dart piloted by Mr. J. A. D. McCurdy makes the first powered flight in the British Commonwealth at Baddeck Bay, Nova Scotia, on February 23, 1909. In the photograph at the top of the page Mr. McCurdy is speaking as the guest of honour at the inaugural dinner of the Canadian Aeronautical Institute in March, 1954.

the Hammondsport race track, flying 600 ft. at a height of 10 to 15 ft. The report said: "A large vineyard directly ahead made a landing necessary. This landing proved rather disastrous to the machine. She struck the ground at too great a speed and turned completely over. Luckily McCurdy was not injured in the least."

He must have been more than worried by that vineyard, for Toronto has never been an easy place to a get a drink, and here he must have thought, " a large vineyard "; of course a landing was necessary!

The third aeroplane built for the Association was by Glenn Curtiss, the June Bug. McCurdy, with the knowledge he was to design and build No. 4, got in as much flying practice as he could and on August 27, 1908, he was able to fly the June Bug for some 2,000 yards, this time landing so that Lt. Selfridge could fly it back. Two days later, on August 29, came McCurdy's first real triumph when he flew two miles in a figure of 8 course, returning for the first time to the starting point without having to land and turn the machine round on the ground. He was now thinking about the design of his own machine, the Silver Dart.

McCurdy looked well ahead in those days to face emergencies before he got to them. "The whole machine is made in sections," he announced at the time, "so as to facilitate repair work, should we be unfortunate enough to have an accident." He had a number, but repairs were quickly made.

The Silver Dart, so named because the wings were silvered on one surface, was a biplane with a gap of 6 ft. 6 in. at the centre section and 6 ft. at the wing-tips. The wings were silk covered, rubber coated on one side.

The A.E.A. in its earlier days had tried to find a substitute for the costly silk, and the Red Wing had first tried wings covered with a cotton material. "It refused to make even an encouraging jump," but when it was realized the material was porous it was given a coat of varnish, and the claim made that this was the first time dope was used to get an aeroplane into the air.

The all-up weight of the Silver Dart was 860 lb. It was powered by a Curtiss 35-h.p. engine. After a few short experimental flights at Hammondsport it was taken to Baddeck, for up to that time no machine had flown in Canada. McCurdy was then acting as secretary to the A.E.A. and called upon to write their reports for publication. Here is his own account of that first flight in 1909:

"On February 23, 'Drome No. 4, McCurdy's Silver Dart, was prepared for a trial. A short flight of one-half mile resulted over the ice at Baddeck Bay. This flight will be memorable in that it is the first flight of a flying machine in Canada. On February 24, a second flight was made in which a distance of four and one-half miles was easily covered at a speed of 40 miles an hour."

Some days later he flew over Baddeck, covering a distance of 12 miles. When he landed he declared with some feeling, "The Wright brothers have my greatest respect for remaining in the air for two hours and 22 minutes."

I think he must have been very proud when he read the following paragraph:—

"The citizens of Baddeck, realizing the importance of the Association's experimental work, felt it would be a mark of appreciation to use their influence as a town with the Minister of Customs to admit, free of duty into Canada, the Silver Dart. This request was granted."

Well, wouldn't you have been proud to have saved the duty if your name began Mc.?

A month later the A.E.A. announced its winding up, as it had done what it had set out to do, and done it in less than two years.

The story of McCurdy from then on will be told at length in Canada in the coming weeks. Here, space in the aeronautical papers is becoming more and more restricted as more and more of it is demanded by guided missiles and those people who like nothing on Earth save to get away from it to the Moon. Some may be glad to get back some day and read about those who started it all on the Earth.

Perhaps I may be allowed a brief recollection of this great Canadian. I first met him on June 3, 1930, at a flying meeting near Ottawa. He was then with the Curtiss-Reid company. I remember the meeting well, for after it there was a dinner, and after that most of us went to the house of General MacBrien to enjoy ourselves. I wonder sometimes if John McCurdy then thought about that vineyard at Hammondsport, for the evening was so lively that I fled at 2 a.m., or thereabouts, overwhelmed by the way these Canadians stood up so steadily in what was then a prohibition State.

Eight days later McCurdy took me over the Curtiss-Reid plant near Montreal. Those were the days of slump and very little was being done in building new aircraft, largely due to the enormous over-production in the U.S. The Montreal plant was chiefly building Curtiss-Reid Ramblers. But though McCurdy bewailed the situation to me and asserted nothing new would be built probably for another two years, I remember, too, that he bewailed still more, as did most Canadians in Montreal, the late arrival of the airship R.100, for the cross-Atlantic trip had seized upon their imagination as the high spot of the year.

Sound, sound the clarion, fill the fife,
To all the aircraft world proclaim,
Each glorious year of flying life
Is worth an age without a name.

That glorious year was 1909. The name, J. A. D. McCurdy.

A Pioneer of Design

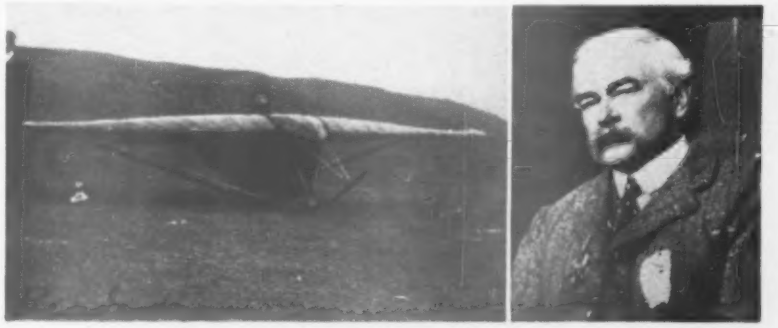
ON January 21 last it was just one hundred years since the birth of José Weiss in Paris who later became a naturalized Englishman. On his death on December 11, 1919, the late Charles Grey, founder editor of THE AEROPLANE, wrote of José Weiss that he was among those to whom aviation of that time and of the future owed most, for to him was due very largely, even if indirectly, the development of the uncapsizable aeroplane. He went on: "Though no aeroplane designed by José Weiss ever flew, in the presently accepted sense of the word, yet he showed many of the successful designers of today what it was possible for an aeroplane to do."

In 1909, José Weiss was experimenting with his gliders at Amberley. At that time he had already achieved considerable success, and had developed the bird-like type of monoplane with which his name was associated. This machine had a stout, stumpy body, with cantilever wings which were swept backwards and upwards, so that the two wing-tips acted as a tail. The wing-tips were, in fact, the whole control, for there was no rudder or elevator.

The experiments at Amberley progressed to the stage of building man-carrying gliders. These were piloted by Mr. Gordon England—later to become famous as a pilot, designer, works manager, and consulting engineer—and by Mr. Gerald Leake. These youths were launched in these frail structures of linen and bamboo lashed together with waxed thread, from the top of Amberley Mount into the up-current of a wind blowing against the hillside. On one occasion Mr. Gordon England rose to a height of 30 ft. or so above the starting-point, landing eventually in the valley nearly a mile away.

The success of these gliding experiments led to the building of a power-driven machine, which did in fact make straight flights on the sands at Littlehampton and at Brooklands. But, owing to an incompetent engine and to lack of knowledge of constructional detail work in the machine itself, it never flew satisfactorily.

Later Mr. Weiss with Mr. Keith experimented with a flapping-wing machine actuated by man-power only. José Weiss himself said that it was actually possible with their experimental machine for a man to lift his weight on the wings with the machine supported on slings between two trees, though they had not ventured to attempt a free flight.



Mr. José Weiss and (left) his glider at Amberley Mount in 1912, Mr. Eric Gordon England at the wing-tip.

Launching Earth Satellites

A SURVEY of the scientific uses and launching of Earth satellites was given on February 12 in a lecture before the Royal Aeronautical Society by Mr. W. H. Stephens, M.Sc., F.R.Ae.S., director-general, ballistic missiles, at the Ministry of Supply. He gave information on all the satellites which have so far been launched and discussed the scientific knowledge gained from observation of their orbits and the instruments they have carried.

Perhaps the most interesting part of his lecture was devoted to the launching and propulsion of both ballistic missiles and satellites. His discussion of the design parameters for launching rockets appears below in a slightly shortened form. Advances in space technology are shown by the hypothetical satellite vehicle Mr. Stephens discussed; this has a launching weight 40 times as great as that of the satellite which it puts into orbit. Less than two years ago this ratio of launching-vehicle weight to satellite weight was put by experts at 1,000 to 1.

Rocket and Satellite Launching

If a missile has an impact range which is half the circumference of the Earth, its speed at the apex of its trajectory approaches orbital velocity and it could be used to launch a satellite.

The range attainable by a single-stage rocket is roughly proportional to the square of the all-burnt velocity. This in turn is a function of the exit velocity of the rocket gases and can be expressed as:—

$$V = V_E \log\lambda - V_1 - V_2$$

where V_E = exit velocity of the gases, λ = total weight at launch divided by weight at all-burnt, V_1, V_2 = velocity losses due to gravity and drag, which, for a given trajectory can be regarded as constant. V_E is related to the specific impulse; for a typical S.I. of 250 sec., V_E = 8,000 ft./sec. Given particular values of S.I., the parameter λ determines the performance obtainable and Fig. 1 shows the impact ranges attainable with a single-stage missile, for various values of S.I., as a function of λ.

From the viewpoint of carrying capacity, a useful parameter is the payload ratio W, which is the total weight at launch divided by the payload weight. With this is connected another important parameter ξ, which indicates the structural efficiency of the rocket. ξ is the weight of usable propellent divided by the total weight of stage (less payload). Obviously W should be low and ξ close to unity for an efficient design. The relation between the three parameters is

$$1 - \frac{1}{W} = \frac{1}{\xi}\left(1 - \frac{1}{\lambda}\right)$$

and is illustrated in Fig. 2 for several values of ξ.

If we remember that a range of 10,800 miles is half-way round the Earth and so almost equivalent to a near satellite orbit, the value of λ required for this range, assuming a specific impulse of 250 sec., is given from Fig. 1 as 30. It is then clear from Fig. 2 that a payload ratio W below 100 can only be achieved if ξ exceeds 0.98; such an efficiency is impractical with any available structural materials.

If we assume a structure consisting of a thin cylindrical shell, divided internally into two compartments for fuel and oxidant, and stabilized by pressure to keep the skin always in tension, then the following weight breakdown might be estimated for rockets with total propellent weights of 100,000 lb. and above:—

Structure weight ..	2½%	of propellent weight
Engine weight ..	2%	.. .. ..
Controls and unburnt propellent	1½%	.. .. ..

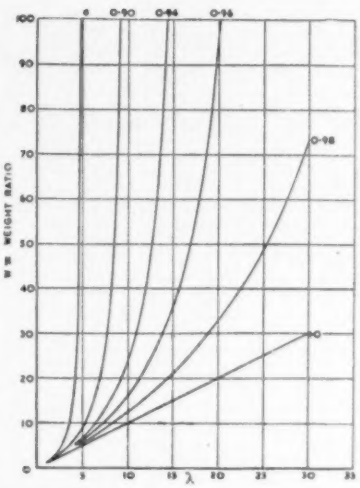


Fig. 2. (Above) variation of payload ratio W with λ for a series of values of ξ, the parameter which indicates structural efficiency.

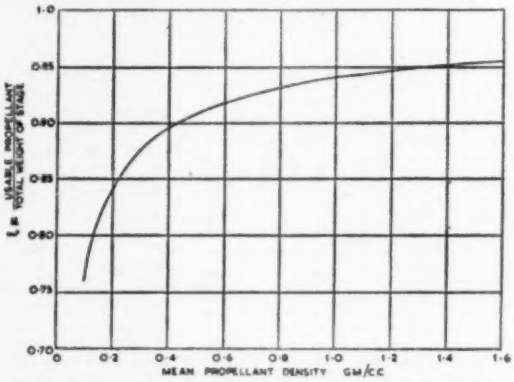


Fig. 3. Variation of ξ with propellent density.

The value of ξ should thus be close to 0.94, and from Fig. 2 we can deduce that the mass-ratio λ must be kept down to less than 15 before a practical payload can be carried. Fig. 2 then shows that, unless a specific impulse greater than 320 sec. can be realized, there is no hope of launching a satellite with a single-stage rocket. In fact the practical value of ξ also depends heavily on the mean propellent density in the way illustrated in Fig. 3.

A high S.I. can be obtained from propellent combinations such as liquid oxygen and liquid hydrogen, but the structural efficiency may be expected to fall off. The density of liquid hydrogen is 0.07 gm./cc. and so the mean density of a 5 : 1 mixture by weight of oxygen and hydrogen, which gives a theoretical sea-level S.I. of 330 sec., is only 0.33 gm./cc. For this density ξ is likely to be approximately 0.88 and from Fig. 2 with λ=12-15, the payload ratio W is obviously infinite so no practical solution is possible.

Thus for signficant satellite weights, using fuels with S.I. below 330 sec., we must turn to the use of staging, and discard en route the useless inertia of such parts as empty fuel tanks. If we assume two stages of propulsion, with a configuration of the type shown in Fig. 4 and further assume the same initial/all-burnt mass ratio for each stage, then Fig. 5 shows the impact range attainable as a function of λ. For a sea-level S.I. of 250 sec., a range of half the Earth's circumference is now attainable with λ=5.5, while with a sea-level S.I. of 350 sec. this can be reduced still further to 3.5.

(*Continued on page 227*)

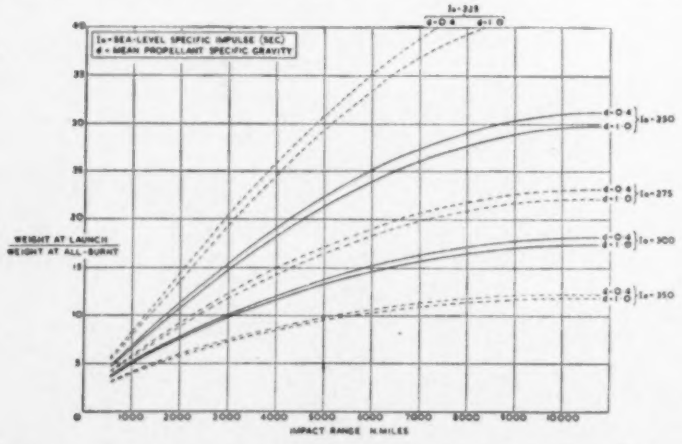
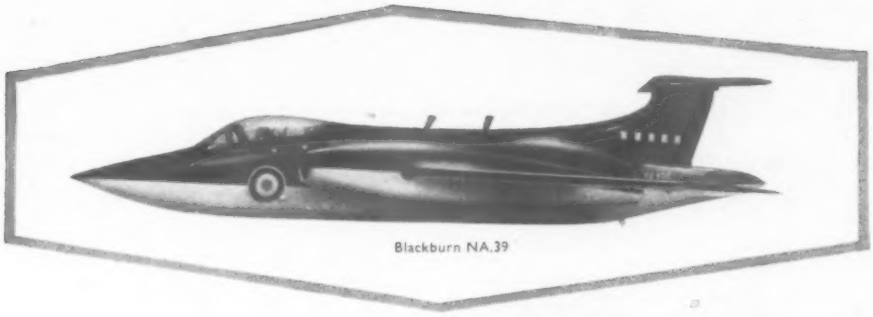

Is = SEA-LEVEL SPECIFIC IMPULSE (SEC.)
ϕ = MEAN PROPELLANT SPECIFIC GRAVITY
WEIGHT AT LAUNCH / WEIGHT AT ALL-BURNT
IMPACT RANGE N.MILES

Fig. 1. Variation of λ—the ratio of launching weight to all-burnt weight—with impact range for single-stage missiles.



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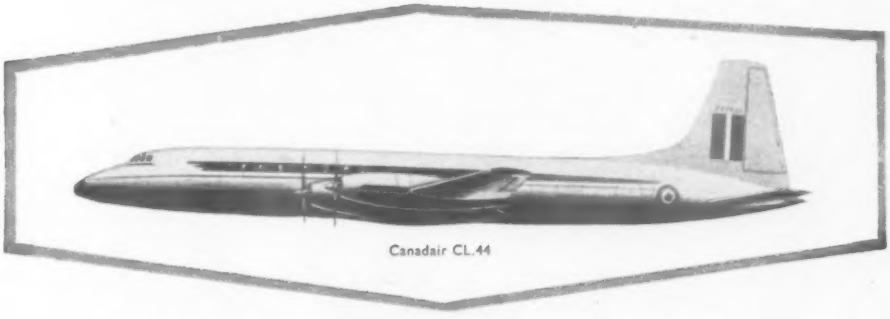

Canadair CL.44

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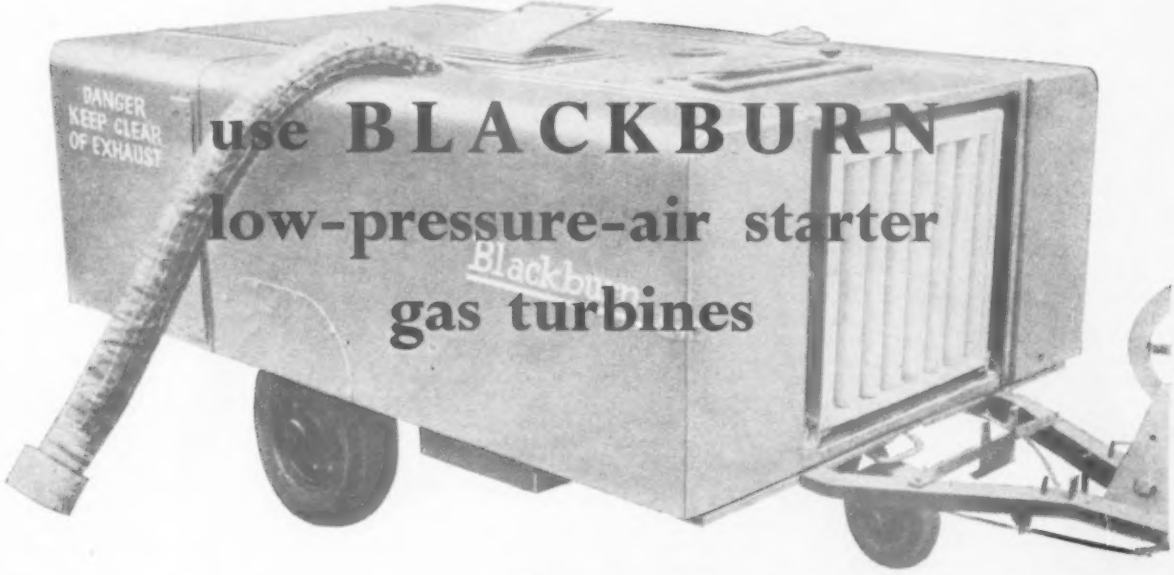

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THE AVIATION SERVICE OF BRITISH PETROLEUM

(*Continued from page 226*)

If we assume a first-stage sea-level S.I. of 250 sec. and a second stage using propellents capable of giving a sea-level S.I. of 300 sec., then a rocket of roughly 200,000 lb. launching weight can project into near-orbit a satellite of about 5,000 lb. as shown in Fig. 4.

Turning to nuclear propulsion, it is clear that the dead-weight of the reactor is likely to limit this form of powerplant to the larger satellites, since otherwise the high S.I.s produced are more than counterbalanced by the poor ratios of

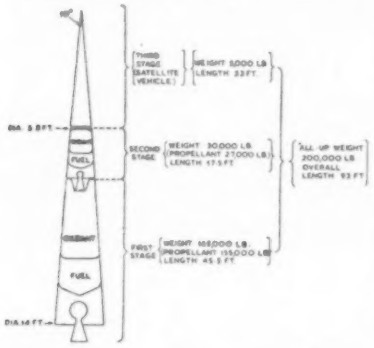


Fig. 4. Layout of a possible satellite-launching missile with an all-up weight of 200,000 lb., designed to put a 5,000-lb. satellite into orbit.

initial to all-burnt weight achievable. The difficulty of achieving high structural efficiency in a nuclear rocket is also increased by the very low density of liquid hydrogen which, because of its low molecular weight, is otherwise a very desirable working fluid.

With a reactor weight of four times the payload a sea-level S.I. of not less than 700 sec. is needed for a range of 10,800 miles, roughly equivalent to a satellite orbit. According to Shepherd a reactor using hydrogen as the working fluid and operating at a chamber temperature of 2,800° K. and 300 p.s.i.a. should give a sea-level S.I. of 800 sec. We might expect, therefore, to be able to launch a two-ton satellite into orbit with an initial weight of 130 tons using a single-stage nuclear rocket. Whether the additional cost and possible radiation hazard would be worth while in this size bracket seems doubtful.

For much larger satellites the high specific impulse promised by nuclear propulsion appears to make it attractive, and Shepherd estimates a 1,000-ton launching weight for a 60-ton payload. But there will no doubt be many problems of reactor materials and structural design.

Guidance

In most of the satellites so far launched no attempt has been made to control the duration of the final thrust precisely, and the tendency has been to give an excess of thrust to ensure that an orbit will be achieved despite errors in the direction of the final acceleration. The result has been to produce elliptic orbits.

In the Explorer satellites, which were four-stage vehicles, the velocity and position at first-stage burn-out were determined by ground observation.

The time to reach the apex of the coasting trajectory was then computed, and firing of the final motor stages was started by radio command from the ground just before reaching apex. The direction of the final thrust was controlled by auto-pilot, which tilted the final stage by air jets to align its axis along the local horizontal at the apex point. By this means, complexity in the final stages of the vehicle was held to a reasonable level, but the method would be subject to considerable errors if a precisely defined circular orbit was an important objective.

For many scientific investigations and especially for reconnaissance and astronomical satellites, it would be necessary to stabilize the satellite (or equipment in it) to a known orientation. Provision of the reference system may prove difficult. For space stabilization the fixed stars are an obvious choice. However, it would be necessary to lock on to two stars prior to launch. In addition, eclipse of these stars by the Earth would necessitate a subsidiary system. Thus it would appear necessary to have a gyro-stabilized platform with the star-tracking system mounted on it.

During the eclipse of the stars the drift of the platform must be small in order that the optical system locks on to the same stars when they come into view. This requirement would specify the accuracy of the stable platform and gyroscopes. Given such a system, the best results would be achieved by a suitable combination of the outputs of the optical system and the gyroscopes.

The theoretical background for making the best use of a mixed system of this type is well understood. It is evident that having gone this far, it might be reasonable to include three accelerometers, mounted orthogonally on the stable platform, to give a complete inertial navigator. Such a system could be used in the boost phase of satellite launching for guidance and could also control the direction and magnitude of the final thrust.

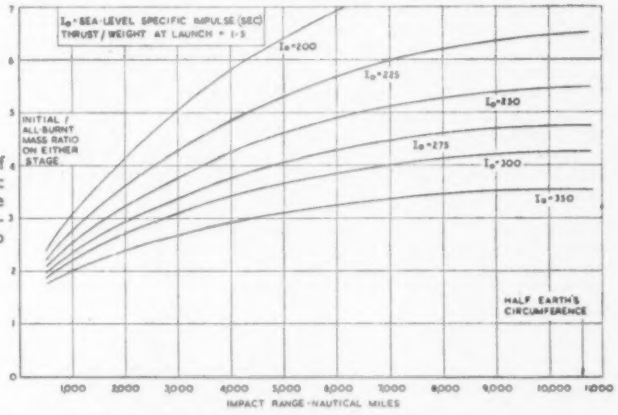


Fig. 5. Range of two-stage ballistic missiles with the same initial/all-burnt mass ratio for each stage.

Post-Graduate Aerodynamics

SUITABLY qualified graduate engineers and scientists may now apply for entry in a one-year diploma course in aerodynamics at the Training Center for Experimental Aerodynamics, near Brussels. The course will be from October 12 this year until July 9, 1960.

The very comprehensive syllabus includes wind-tunnel design for all flow regimes; instrument design; supersonic nozzle design and calibration; flow-visualization; pressure and force measurements; boundary-layer survey; non-stationary flow; spinning tunnel tests; and electronics.

There are no fees for the course and there are a number of student fellowships to cover living expenses. Students must speak fluent English or French. Full information and application forms (which must be returned by April 18) are available from The Director, Training Center for Experimental Aerodynamics. 72 chaussée de Waterloo, Rhode-Saint-Genèse, Belgium.

The Center was established two years ago to operate post-graduate courses for aerodynamicists of NATO countries and was described in THE AEROPLANE for March 14, 1958. It is extremely well equipped and is situated in a very pleasant part of Belgium, not far from Brussels.

Professor Theodore von Kármán is chairman of the board of directors and Professor L. H. G. Sterne is the director. Professor Sterne was formerly Chief Superintendent of the Royal Aircraft Establishment at Bedford.

In addition to the one-year courses, the Center runs short courses on subjects related to aerodynamics and invites "celebrity" lecturers from time to time to discourse on their particular line of work. As a NATO establishment it performs a most valuable rôle in improving technical efficiency and providing a common meeting place for young aerodynamicists from all the NATO countries.

Selling British Sailplanes

ON the first two days of the National Gliding Championships, which are to be held at Lasham Gliding Centre, Hants, from May 9 to 18, there will be a National Glider Trade Fair, organized by the British Gliding Association to further the sales of British sailplanes and equipment.

This will be the first fair of its kind, and stands will be available to companies who make various pieces of equipment used by the gliding organizations. The B.G.A. is confident that large sales from both Britain and overseas will result.

The exhibition area will be in a new hangar which has been put up. Further particulars can be obtained from the Association, 19 Park Lane, London, W.1.

Photographs copyright "The Aeroplane"

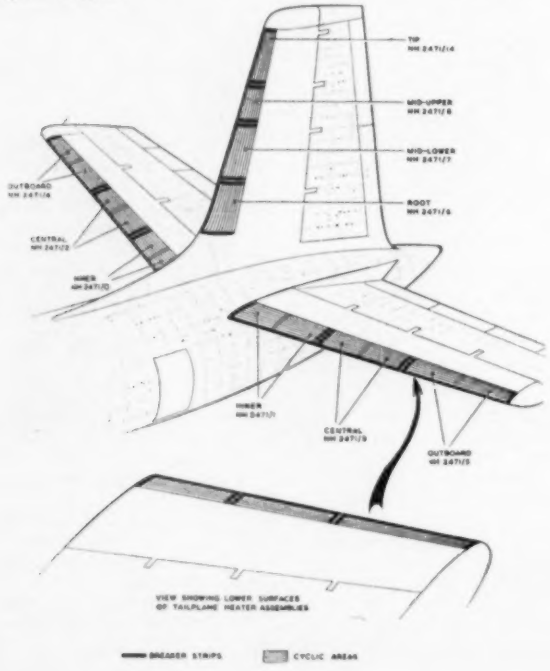
At Londonderry House in London on February 12, Air B.P. were hosts at a reception for members of the British Independent Air Transport Association. (L. to R., upper and lower) A. M. Blakemore (Secretary B.I.A.T.A) with J. C. C. Taylor (Air B.P.); H. C. Kennard (B.A.S.), J. Sanderson (Air B.P.) and Mr. Rees Jenkins (Air B.P.); J. C. Harding (Airwork) and B. C. Seed (Air B.P.); C. P. M. Hunting, Sir Wavell Wakefield and Mr. J. Grant (Air B.P.); Harold Bamberg with the Editor of THE AEROPLANE; Fred Collins (Air B.P.), E. Banbury (Airwork) and the Hon. K. Davison (Airwork).

De-icing the Vanguard's Tail

NAPIER'S Spraymat system which gives protection against ice on the tail units of the Vickers Vanguard turboprop airliner, meets the requirements of the A.R.B. and F.A.A. in respect of "continuous maximum" ice conditions. The system in the Vanguard uses 10 separate heaters, four on the fin and six on the tailplane, each heater being built up on a quickly detachable leading-edge section.

In icing conditions, the extreme leading-edges and the inboard and outboard ends of each section are heated continuously to prevent the formation of ice on these areas. The remainder of each section is heated intermittently to shed ice

The complete installation comprises 20 intermittently heated areas, some of which are interconnected, forming a total of 13 groups. These groups are the "cyclic areas," the heaters on which are supplied via a three-phase, 13-way Austinlite cyclic switch.



This is a motor-driven, two-speed switch which gives a "time on" of 10 sec. or 20 sec. at each contact, speed selection being made by a cockpit switch. Thus, one complete de-icing cycle on the tail unit leading-edges takes place in 130 or 260 sec., each cyclic area being unheated for 120 or 240 sec. during which period ice accumulates.

Adhesion is broken, and the ice shed, during the 10 or 20 sec. of "heat on." This system results in very considerable savings in electrical energy, and alternator weight, since the load on the alternator due to the de-icing system never exceeds 34.2 kW., whereas, were the entire installation continuously heated, 218.4 kW. would be required.

Spraymat heaters comprising the Vanguard tail unit installation are straightforward in design and construction. Each heater is built up directly on the leading-edge section with a base insulation of synthetic resin and glass cloth. The heating element consists of flame-sprayed Kumanal, and the outer insulation is similar to the base insulation, without glass cloth.

To provide added protection against the assaults of hail or runway debris the area for 6½ in. on each side of the leading-edge centre line is covered by the newly developed Napier anti-damage coating which consists of particles of a special stainless alloy bonded with synthetic resin.

The protected area is symmetrical about the leading-edge on the fin, but the heaters on the upper surface of the tailplane cover a greater area than those on the lower. Breaker strip heater circuits on the inboard heaters have a lower heating intensity than those at the tip of each main component. On the fin the range is from 9.4 to 11.5 W./sq. in., and on each tailplane the breaker strip heating intensity increases from 10.0 to 12.8 W./sq. in. from root to tip. Cyclically operated heaters run at a heating intensity of 15.0 to 16.0 W./sq. in.

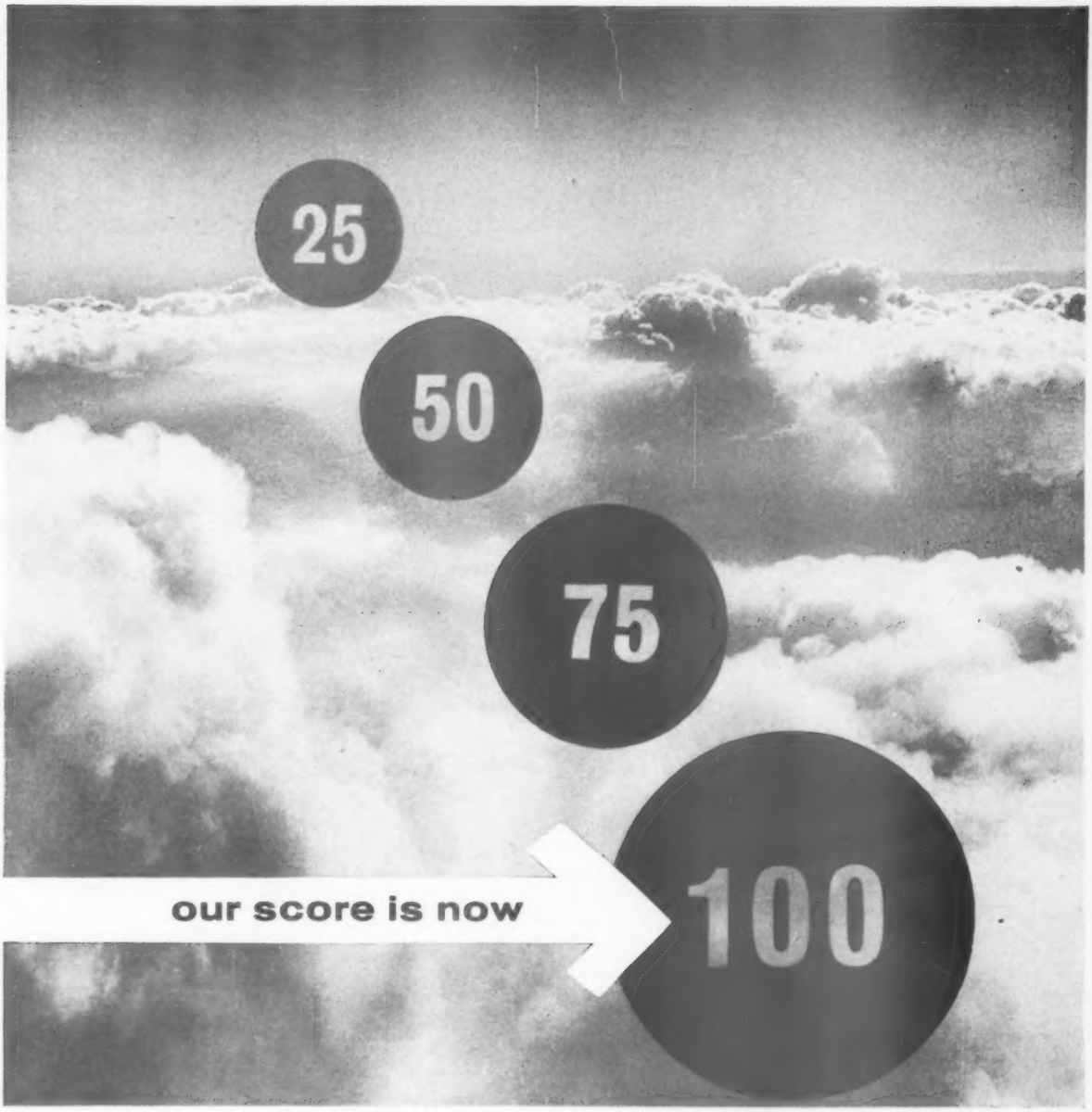
Starfighter Statement

THE Federal German Minister of Defence has given details of the Lockheed F-104 orders for the Luftwaffe.

Of the 96 Starfighters to be purchased from the Lockheed company, at an individual cost of DM 5,200,000, 30 would be two-seat trainers and the rest equipped as "multi-mission interceptors." The latter would be equipped with the most modern weapons and electronic systems to 1961 standards.

Deliveries of the first Starfighters, which would be the training aircraft, will start later this year. The main Luftwaffe order for at least 200 more Starfighters would be completed under licence by the German aircraft industry, negotiations having been completed "to the mutual satisfaction" of the companies concerned.

The Starfighter was selected by Germany after the evaluation of 14 current interceptors—three British, one Swedish, two French and eight American.



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An intensive and thorough evaluation carried out with Mk.1 aircraft has paved the way to the current production version, the Mk.3. Refinements include hydraulically operated services, Martin-Baker ejection seats, wing-tip auxiliary fuel tanks and a one-piece moulded windscreen.

All Jet Provosts are powered by the Armstrong Siddeley Viper turbojet.

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(*Continued from page 211*)

SEA HAWK OPERATIONS.—Now visiting Holland is No. 800 Squadron, F.A.A. (Lieut.-Cdr. A. A. Fyfe, R.N.), based at Brawdy and equipped with Sea Hawks. During the visit—February 10 to 25—the squadron will be accommodated at the R.Neth.N.A.S. Valkenburg, and will exercise with the R.Neth. Navy, which also has two Sea Hawk squadrons.

TURBOFAN PROJECTS.—Pratt & Whitney is reported to have projects for turbofan versions of its JT-4A (J75), JT-8 (J52) and JT-12 (J60) turbojet engines, the latter with a rating of 4,000 lb. s./t. The turbofan JT-8 is one of the engines currently being considered by Boeing and Douglas for their short-haul transport projects—the 727 and DC-9.

NEXT WEEK

"THE AEROPLANE" for February 27 will be a special issue devoted to

"MATERIALS AND PROCESSES"

employed in the aircraft industry. It will cost the usual 1s. 6d.

SIKORSKY RESEARCH.—Direct-lift aircraft of all types, including VTOL and STOL, are to be studied by the Sikorsky Aircraft Division of United Aircraft Corpn. in addition to helicopters.

NOISE DISCUSSIONS.—The Acoustics Group of the Physical Society is sponsoring two symposia on noise and vibration. The first is at 14.15 hrs. on March 24 in the Physics Department, Imperial College, London, S.W.7.; it is open to all. Recent work on the measurement and effects of noise will be surveyed. The second is a one-day joint meeting with the Institute of Physics; it will be held on April 7 in the Physics Department, Southampton University, and will cover new techniques in the analysis of noise and vibration. Further details can be obtained from Mr. D. M. A. Mercer, Physics Department, Southampton University.

Howard Levy photograph

HIGH FLYER.—The Lockheed U-2 aircraft for high-level operations is powered by a 10,000-lb. thrust Pratt & Whitney J57C turbojet; it is known to operate at above 55,000 ft. for reconnaissance, atomic fall-out and weather surveys. This U-2 is of the 4028th SAC Reconnaissance Squadron (Weather), at Laughlin A.F.B., Texas, and Ramey A.F.B., Puerto Rico.

PRESSURIZED B-26.—Lockheed Aircraft Service, Inc., has developed a mod. scheme for the Douglas B-26 executive conversions to provide a pressurized fuselage. The conversion package provides for enlarging and strengthening the entire fuselage, tip fuel tanks, air-stair door, larger windows and other changes. With two 2,400 b.h.p. P. & W. R-2800 engines, the pressurized B-26 weighs 35,000 lb. and will cruise at 375 m.p.h. over 2,500 st. mile ranges.

ITALIAN MISSILES.—The Finmeccanica company is among European firms chosen to produce the U.S. Hawk ground-to-air missile. The French Thomson-Houston concern will co-ordinate the production programme.

CESSNA SESSION.—On February 7 a Cessna 172 landed at Las Vegas, Nevada, 64 days, 22 hr. and 21 min. after taking off. Sharing this record were John Cook, an airline pilot, and Bob Timm, a business man. Fuel, food and mail were picked up by flying low over a moving lorry.

News About People

B.O.A.C. CHANGE.—Sir Duncan Cumming has relinquished, at his own request, his appointment as managing director of B.O.A.C. Associated Companies but remains on the board. Mr. John Linstead, previously the London manager, has been appointed general manager.

AIR LEAGUE COUNCIL.—The appointment of three new members of the council of the Air League of the British Empire is announced. They are Mr. Peter G. Masefield, managing director of Bristol Aircraft, Ltd., the Hon. Hugh Astor, a director of *The Times* and a qualified helicopter pilot, and Mr. Percy Hunting, chairman of the Hunting Group. A former member of the council, Sir Miles Thomas, has accepted an invitation to become a vice-president.

ORDNANCE CHIEF.—Air Vice-Marshal J. F. Franks, C.B., C.B.E., is to succeed Rear Admiral H. S. Walkley, R.N. (Retd.) as president of the Ordnance Board.

M.o.S. POST.—Mr. H. E. Drew (right) has been made Director of Electronics Production (Air) in succession to Mr. R. E. Sainsbury, who is attending the 1959 course at the Imperial Defence College.

U.S. RESIGNATION.—Mr. David Smith, assistant secretary of the U.S.A.F., resigned on January 31.

ACOUSTIC MANAGER.—Mr. J. D. Sinclair has been appointed manager of the industrial division of Amplivox, Ltd., and will be concerned with marketing electro-acoustic equipment in the aeronautical and industrial communications field. He was formerly assistant chief of sales with Muirhead and Co., Ltd., of Beckenham.

WARRINGTON CHANGES.—Mr. A. Harold, A.F.R.Ae.S., a director of Conveyancer Fork Trucks, Ltd., and chief engineer of Electro-Hydraulics, Ltd., and Mr. R. Edwardes, A.C.W., A.C.W.A., director and secretary of the former company and secretary of the latter, have been appointed to the board of Electro-Hydraulics. Mr. T. C. Wright, director and works manager of Electro-Hydraulics, has been appointed to the board of Conveyancer Fork Trucks.

Hugo Junkers

FEBRUARY 3 was the 100th anniversary of the birth of Professor Hugo Junkers, founder—in 1895—of the great German industrial concern and of the aircraft works which bore his name. He died in 1935, on his 76th birthday.

Hugo Junkers was born at Rheydt, and was trained as an engineer. As early as 1910 he patented an all-wing aeroplane, twin-engined, with accommodation for freight and passengers within the wing, but neither materials nor engines then existed for it to become a practical proposition. The first Junkers all-steel aeroplane was built in 1915, and a light-alloy version appeared the next year.

The aircraft company was founded at Dessau in 1919 and then began the long series of highly practical transport monoplanes, beginning with the F-13 and progressing through the G-24, G-31, G-38 and the ubiquitous Ju 52, built in single- and three-engined versions. The Ju 52 was among the soundest aircraft ever built, a crude and robust engineering proposition, and very safe.

Polished aerodynamics seemed to play little part in Junkers designs, yet their record for reliability and economy is barely surpassed, and versions of the Ju 52 are still flying today. Characteristic of the Junkers monoplanes was the entirely hinged trailing edge, the outer sections operating as ailerons and the inner portions as camber-changing flaps which kept down landing speeds.

Junkers also pioneered air transport in Germany, forming an airline in 1921 which later merged with Deutsche Lufthansa. In 1927 he produced his first heavy-oil aero-engine, developments of which powered the Ju 86 commercial monoplane.

Commercial Aviation Affairs

B.O.A.C. PACIFIC SERVICE.—By extending their London-San Francisco Britannia service across the Pacific to Tokyo and Hong Kong, B.O.A.C. will be able to offer a round-the-World service after March 31. On that date, the first Britannia service for Hong Kong will leave L.A.P.; stops will be made at New York, San Francisco, Honolulu, Wake Island and Tokyo. On April 1, the first Comet on the eastabout route to Hong Kong and Tokyo will leave London Airport (see THE AEROPLANE, February 6, 1959). Total elapsed time, from London back to London, will be about 87 hours when flying eastwards round the World.

PARIS COMPROMISE? — The I.A.T.A. Traffic Conference resumed in Paris on February 16 the discussion of the controversial jet differential proposal which caused a breakdown in the talks at Cannes last year. With an open rate war threatened after March 31 if no agreement is reached, a compromise is likely, but pre-Conference talks last week gave no clue to its possible nature. Meanwhile, both National and American Airlines, flying Boeing 707s on domestic service in the U.S.A., have introduced a flat $3-$10 surcharge to help offset the costs of introducing new equipment.

QANTAS ROLL-OUT.—The first Boeing 707-138 for Qantas was rolled out on February 16 and will be the first 707 delivered to a foreign customer. The seven Qantas 707s will each seat 30 first-class and 60 tourist passengers and will be used on the round-the-World service through the U.S.A., Europe and India.

COACH CLASS APPLICATION.—Among the latest applications for scheduled service rights made to the A.T.A.C. is one from Air Charter, Ltd., for two Colonial Coach class services, from London to Malta and Cyprus, and from London to Kano and Lagos (with a technical stop at Tripoli). An initial frequency of once a fortnight on each route is requested, using DC-4s and Britannias. Also specified for later use are the Viscount, Comet, Vanguard, DC-6, DC-6A or DC-6B.

CONVAIR PROGRESS. — In five flights during its first week of flight testing, the Convair 880 accumulated 11 hours 16 minutes in the air. It returned to Lindbergh Field, San Diego, on February 3 with an experimental C. of A. and will be based there for further test flights.

SECOND FOR CUBA.—The second Britannia 318 for Cubana arrived at Havana on February 7. The first Cubana Britannia flew 112 hours on passenger service, and carried over 1,500 passengers, between December 17 and January 18 on the services from Havana to Mexico City, New York and Miami.

EXCHANGE NEWS.—Latest *Market Report* from the Aircraft Exchange shows DC-7s on offer for the first time, on both a sale and a lease basis and for multiple sources. For immediate sale, prices asked range from $995,000 to $1,200,000 each; the lease price is $35,000 per month.

BRITANNIA WORLD CIRCUIT.—The Britannia 306 operated by Air Charter last week completed a round-the-World, 26,100-mile flight in 72 flying hours. It took service personnel to Adelaide and Sydney via Bahrain, Ceylon and Singapore and then flew on to Christmas Island to pick up more servicemen. The return flight was via San Francisco and Montreal.

B.E.A. APPOINTMENT.—Mr. P. C. Pinfield has been appointed assistant traffic manager at the B.E.A. Head Office. He has been with B.E.A. since 1946, and became manager, London Stations, in 1955.

VIKING CRASH INQUIRY.—The public inquiry into the accident to the Independent Air Travel Viking at Southall last December will open at Holborn Town Hall on March 16.

LA GUARDIA AFTERMATH.—While investigations into the La Guardia accident (see last week's issue, p. 186) were in progress the Federal Aviation Agency initially limited all Electra operations to approach minima of 1,000 ft. and two miles by night (or one mile by day). Later the F.A.A. permitted the use of normal minima after altimeters of the standard three-pointer type had been fitted in replacement of those with a newer presentation. This revised presentation is prospectively less ambiguous with a single needle for sensitive readings over a 1,000-ft. scale and a counter (or drum) giving the thousands.

UNITED JETWAYS.—Nine Jetway elevated passenger loading walks have been ordered by United Air Lines from Pacific Iron and Steel Corporation for use at Idlewild. Extending at first-floor level from the terminal, the Jetway can be adjusted in length and height to match DC-6, DC-7, DC-8 and Boeing 720 passenger doors.

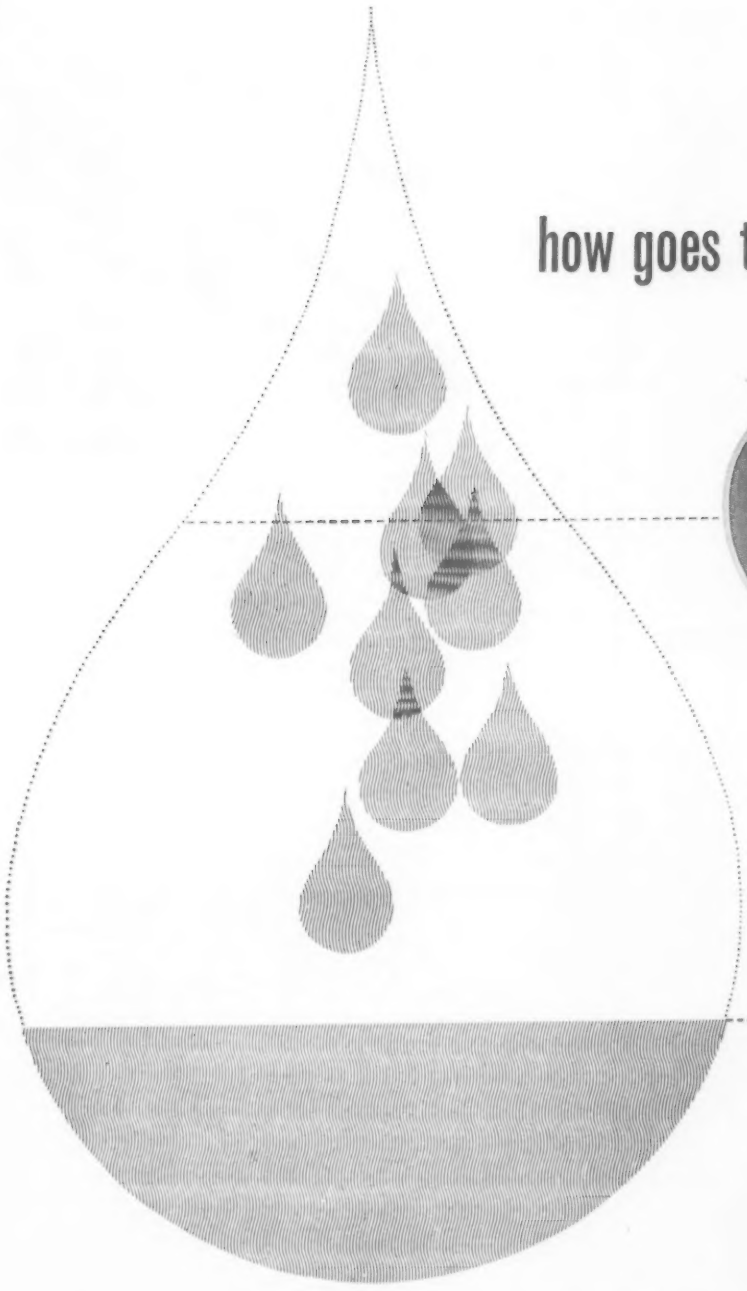
IFALPA CONFERENCE. — The annual conference of the International Federation of Air Line Pilots' Associations is being held this year in Helsinki from March 10 to 17. The many items on the agenda will include the consideration of directives for the Federation's representatives at future ICAO meetings and of reports from such meetings already held.

DAY TRIP DETAILS.—From March 31 to September 30, Silver City will carry "no-passport" day trippers between Lydd and Le Touquet on certain regular car ferry services each day. No advance bookings will be accepted and availability of seats cannot be guaranteed. Fare will be £3 5s. From June 2 to September 30, on Tuesdays, Wednesdays and Thursdays, a special "wheels and wings" service will also operate, leaving London (by coach) at 07.00 hrs. and reaching Le Touquet at 10.50 hrs. The return flight will leave at 18.30 hrs. and the fare will be £3 15s. 6d.

RETURN TO EGYPT.—Following the recent news of a charter flight to Cairo by Overseas Aviation (C.I.), Ltd., we are informed by Dan-Air that they operated a Dakota flight from Amsterdam to Cairo as long ago as August 25, 1957. Continental Air Services, Ltd., took a Viking to Cairo on January 1 this year.

FORTY FRENCH YEARS.—At London Airport on February 10 Air France celebrated the 40th anniversary of French commercial aviation. On the right, signing the A.F./B.E.A. agreement (page 212), are, left to right, J. Bamford, standing (A.F. general manager, U.K.); Michel de Villeneuve (A.F. commercial director); D. Grey (B.E.A. commercial manager), and B. Bartlett (B.E.A. commercial agreement superintendent). The picture above, taken at Croydon in 1926, shows British, French and Dutch pioneers. Left to right they are, C. A. Wolley Dod, B. Youell, M. Corsin, Emile Bouderie, R. H. McIntosh, J. W. Brackley, R. Bajac, W. Rogers and W. Warner.

how goes the fuel?



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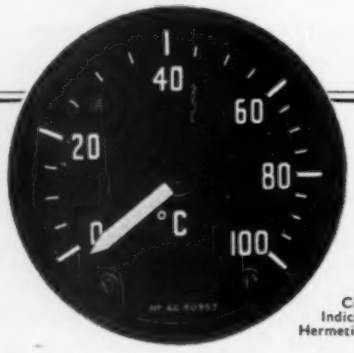

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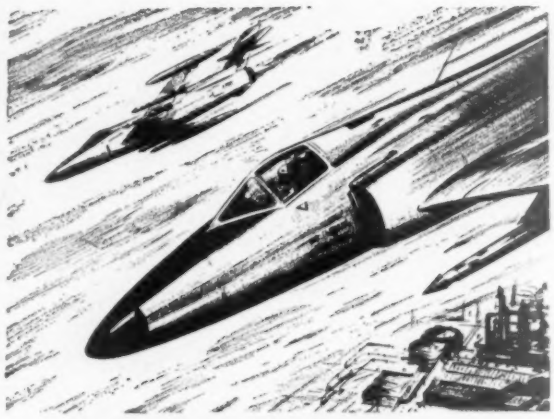

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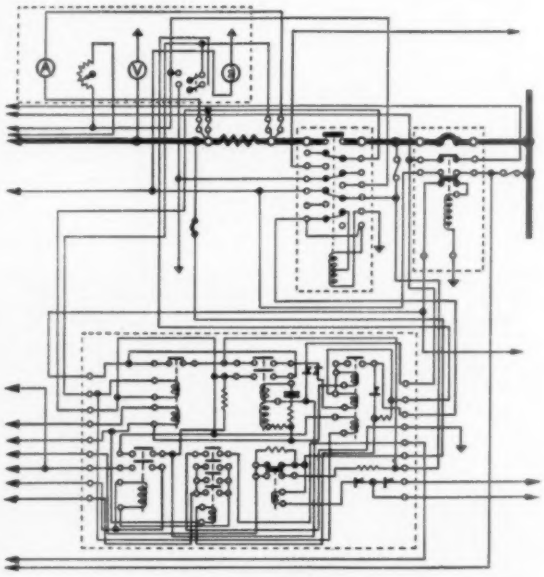

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Correspondence

Verbal Aerobatics

WITHOUT wishing to detract in any way from the inventive ability of Mr. Norman Jones, it is only fair to remark that the term "voltige" as applied to aerobatics has been in use by the French for a number of years (THE AEROPLANE, January 30).

It used to be employed in the term *voltige aerien*—which was at first a necessary qualification of the basic word—but that word now stands alone as a useful addition to the French language. It is pleasant to find the French adding a native word to their own tongue; somehow one never quite gets used to *le briefing* and *le parking* (though it is said that the first of these foreigners is to be replaced by a splendid new French word *le briefage*).

Outside aviation, of course, the habit is even more widespread; *stopper* for *arrêter* one might condone, but why, in heaven's name, *le staye* for *la visite*? But that is outside the scope of this letter.

London, W.1. J. H. BLAKE.
Librarian, R.Ae.S.

A Tough Assignment

I WAS looking through a volume of old copies of THE AEROPLANE for 1924 and in the March 26 (1924, No. 13, Vol. XXVI) copy I came across the following passage which will no doubt amuse you:—

Page 258. Title of paragraph, "The State of the British World Flight." In the last sentence of the second paragraph it states:—

"Lt.-Col. L. E. Broome will be used in place of the undercarriage to ensure the safe passage of the machine through the Aleutian Islands."

Nuthall, Notts. F. A. GIBSON.

The Green Engine

BERT HINKLER'S Green-engined Baby Avro didn't win the Aerial Derby Races in 1919 and 1920 (THE AEROPLANE, January 23). He won the Handicaps. And so far as I remember H. A. Hamersley in a similar Baby wasn't far behind. I remember seeing them turn Epsom Grandstand almost wing-tip to wing-tip. In May, 1920, Bert flew the same aircraft non-stop from Croydon to Turin, 650 miles, in 9¼ hr. for which he was awarded the Britannia Trophy. He hoped to fly the Baby to Australia but as the Middle East was in its usual state of unrest with a rising in Iraq in full cry the British Government stopped him.

London, S.W.5. GEOFFREY DORMAN.

[The 1919 Aerial Derby was won by an Airco D.H.4R (450-h.p. Napier Lion engine), flown by Capt. G. Gathergood, and first in the Handicap was the 35-h.p. Green-engined Avro Baby of Capt. H. A. Hamersley. Bert Hinkler did not take part.

The Martinsyde Semi-Quaver (300-h.p. Hispano-Suiza engine), piloted by Mr. F. T. Courtney, won the 1920 Aerial Derby and Capt. Hamersley, flying his Baby, was again winner of the Handicap. Bert Hinkler, flying his Baby, was second, finishing six minutes later than Capt. Hamersley.—ED.]

Ocean Air Control

THE article "A.T.C. Over The North Atlantic" (THE AEROPLANE, December 19 last) was read with particular interest.

Having worked directly with this problem over the last eight years, I noted a number of very familiar recommendations. Although some progress has been made over the years, there is still a long way to go and only by continued pressure for improvement by the administrations concerned, and the users of the airspace, can we hope to have an Oceanic Air Traffic Control system as up to date as the aircraft being controlled.

It's nice to have a fellow like Ted Pike on our side.

R. H. SMITH
(Regional Superintendent, Air Traffic Control).
Moncton, N.B., Canada.

South American Services

YOUR article "Squabble in the Sun" (January 23 last) was very interesting—let us have more like it, as very little is written about South American air transport—but please let us have the facts correct. Your correspondent writes of Brazil's Real S/A operating three DC-4s and quotes a Buenos Aires-New York route. The facts are that Real do not operate into New York, but to Miami/Chicago (with a Westcoast U.S.A.-Tokyo service planned), and that they withdrew their DC-4s from international service in the middle of 1958, replacing them with L-1049Hs (PP-YSA to D)—see "Airlines of the World" issue of 7.11.58.

The agreement between Argentinas Transcontinental and Brazil's Real to offer a daily Buenos Aires-U.S.A. flight came into operation just before I left Brazil in September, 1958.

Although using standard fares, surely Brazil's S/A Varig, the only direct East Coast competition to P.A.W.A. into New York, is worth a mention, especially as Conway-powered 707s are on order.

South American operators' ideas of a DC-3 replacement should be worth a column in your magazine.

Heathfield, Sussex. G. F. BEAN.

Groundabout

On, On . . . There seems to be some sort of vague connection between two items which have caught my eye. The first, in a booklet from Avro outlining their history (they are 50 this year): "In 1912, the first British Government order for three biplanes was received. This meant overtime . . . and the first machine was delivered in less than eight weeks." And costing, I believe, less than £1,000 each. The other item, reprinted in the *S.B.A.C. Press Summary* under the heading "'ARROWS' OFFERED CHEAP TO R.C.A.F." quotes *Aviation Daily*: "Avro Aircraft, Ltd., reportedly has offered to build 100 CF-105 Arrow supersonic interceptors for the R.C.A.F. at $3,750,000 each. This figure represents production costs only and does not include development costs, spare engines or armament." This is cheap?

*

"My condolences, Comrade Squadron Commander—I hear you have lost one of your most cherished Ilyushins. . . ."

*

pihsnamllehS . . . All the way from Burmah-Shell's Bombay H.Q. comes the Diary that is Different—it works backwards. Beautifully produced, it is designed for right-handed people to use while 'phoning and, by heavens, it works—with a little practice. Friends of John Swabey, Burmah-Shell's aviation manager, will not be surprised to know that he had a hand (the right one) in this novel device. Soon, after 27 years of building B-S into India's biggest aviation fuelling organization, he's retiring. His assistant for the last 12 years, Charles Rossiter-Smith, who worked at the R.A.E. on early jet development and then went to Power Jets, is taking over in—er, September, August, July—ah, here it is—June.

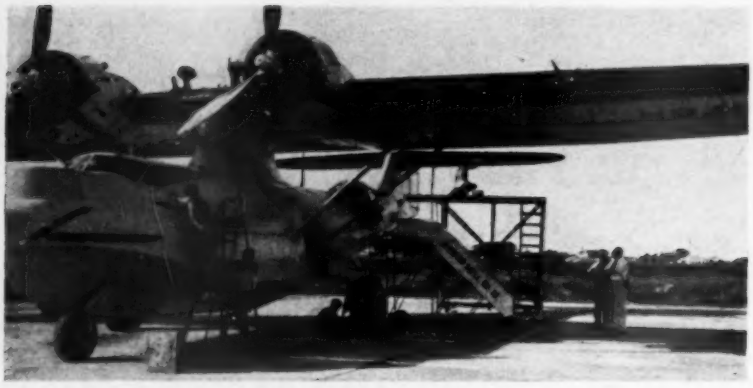
*

*

Flying Saucers Latest. An amusing letter from Henry West, a Press friend in Wales: "After my Ascot gas water heater was serviced by a gas fitter (or was he from Rolls-Royce?) it developed afterburning. For three turns the hot tap now works normally but the fourth produces a bang, a roar and a wonderful surge of power. On more than one sortie, I've achieved Mach 2 with the dinner dishes—in fact washing up is the nearest thing to flying the Lightning that I shall ever know. But I'm a bit worried by the j.p.t." I expect water injection comes into it somewhere.

by Gresley

NOTES AND EVENTS



SUBMARINE SEARCH.—Used by the Pakistan Shell Oil Co., Ltd., in a search for oil in the Bay of Bengal, this Catalina is specially equipped to record the rock strata under the sea bed while it taxies on the surface of the water.

MARCONI IN INDIA.—A new calibration centre is to be set up in Delhi by Marconi Instruments, Ltd., of St. Albans. Mr. J. E. Taylor, a technical sales engineer of the commercial department, has been seconded to the company's Indian agents, Associated Instrument Manufacturers (India), Private, Ltd., to assist in the work. The centre will be equipped with a wide range of instruments and provide up-to-date facilities for users of telecommunication-measurement equipment.

ULTRA EXPORTS.—Ultra Electric, Ltd., of Acton, London, W.3, has received a further order for Sonobuoys from the Federal German Government, bringing to more than £500,000 the total value of orders received from West Germany. The orders also include the supply of SARAH radio rescue beacons, DF equipment and test equipment.

NAME CHANGE.—The Institution of Electrical Engineers announces that as from February 5 the name of the Radio and Telecommunication Section is changed to the Electronics and Communications Section. The incorporation of the word "electronics" is intended to emphasize that the Institution "is manifestly the learned society for those properly qualified electrical engineers who regard themselves as electronic engineers." The word "radio" is no longer considered comprehensive enough, and the continued inclusion of such interests as navigational-aid systems and radar was felt to justify a new title. "Communications" may be broadly interpreted within the context of electrical engineering.

MOND NICKEL FELLOWSHIPS.—The Mond Nickel Fellowships Committee now invites applications for the award of its 1959 fellowships. The main object of these fellowships is to enable selected applicants of British nationality and educated to university degree standard to obtain additional training in industrial establishments, so that, if they are subsequently employed in executive or administrative positions in the British metallurgical industries, they will be better qualified to appreciate the technological significance of research and to apply its results. Each Fellowship will occupy one full working year, and full particulars and forms of application can be obtained from the secretary, Mond Nickel Fellowships Committee, 4 Grosvenor Gardens, London, S.W.1.

CONFERENCE PAPERS.—Under the title "Bonded Aircraft Structures," CIBA (A.R.L.), Ltd., of Duxford, Cambs., has published in book form the papers given at a conference held at Cambridge in 1957. This was organized by the company (then known as Aero Research, Ltd.). Measuring 8½ in. by 11 in., the book costs £2 12s. 6d. ($7.50) post paid to any part of the World.

Company Notices

NEW COMPANY

Saro-Nuclear Enterprises, Ltd. (619,746).—Private co. Reg. Jan. 27. Cap. £10,000 in £1 shs. (2,500 "A" ordinary and 7,500 "B" ordinary). Objects: To carry on research, development and production in the field of nuclear science, and to carry on the business of exporters, importers and manufacturers of and dealers in equipment, instruments, goods, chemicals and materials necessary or ancillary to the carrying on of such matters and business, etc. Subscribers (each with one "B" sh.): James Stewart, 6 North St. David St., Edinburgh, solicitor; and Norman H. P. Taylor, The Crossways, East Cowes, I.o.W., certified accountant. First directors shall be three persons nominated by Saunders-Roe, Ltd., and two by Nuclear Enterprises (G.B.), Ltd. Solr: P. D. A. Clarke, 47 Parliament St., London, S.W.1. Reg. off.: Osborne, East Cowes, I.o.W.

New Patents

APPLICATIONS ACCEPTED

810,749.—Sir W. G. Armstrong Whitworth Aircraft, Ltd.—"Shock tube."—Aug. 14, 1956.

810,814.—Raymond De-Icer and Engineering Co., Inc.—"Antennas and material for the manufacture thereof."—May 24, 1956.

810,824.—Fairey Aviation Co., Ltd.—"Aircraft."—June 21, 1956 (March 24, 1955).

810,867.—Smith, S., and Sons (England), Ltd.—"Navigational instruments."—Nov. 8, 1956 (Sept. 9, 1955.)

810,951.—Guinness, N. D. L.—"Aeroplanes and other aircraft."—Oct. 11, 1955. (Oct. 11, 1954.)

810,957.—Curtiss-Wright Corporation.—"Flight training apparatus for simulating low-level flight."—April 17, 1956 (April 21, 1955).

811,061.—Sperry Rand Corporation.—"Aircraft navigation instruments."—June 1, 1955 (June 11, 1954).

811,062.—Sperry Rand Corporation.—"Altitude indicating instruments for aircraft."—July 15, 1955 (Aug. 2, 1954).

811,063.—Sperry Rand Corporation.—"Aircraft indicating instruments."—June 1, 1955 (June 11, 1954). (Divided out of 811,061.)

Applications open to public inspection on March 25, 1959; opposition period expires on June 25, 1959.

811,211.—McCutchen, C. W.—"Cyclic pitch controls for helicopters."—July 15, 1955 (April 15, 1954).

811,212.—McCutchen, C. W.—"Cyclic pitch controls for helicopters."—Jan. 9, 1956.

811,300.—Dunlop Rubber Co., Ltd.—"Braking system for aircraft."—May 11, 1956 (June 1, 1955).

Applications open to public inspection on April 2, 1959; opposition period expires on July 2, 1959.

Aviation Calendar

February 24.—R.Ae.S. lecture, "The Flight Development of an Aircraft Before and During its Operation," by Dr. A. E. Russell, C. Abell and Dr. E. J. Warlow Davies, in the library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

February 25.—Aerodrome Owners Association, A.G.M. at Londonderry House, 19 Park Lane, **London,** W.1, at 15.00 hrs., followed by annual dinner at the Hyde Park Hotel, **London,** S.W.1, at 19.00 hrs. for 19.30 hrs.

February 25.—Kronfeld Club talk, "Some Medical Aspects of High Speed and High Altitude Flight," by Dr. R. Wombeek, at 74 Eccleston Square, **London,** S.W.1.

February 25.—R.Ae.S. Graduates and Students Section lecture, "Deck-Landing of Naval Jet Aircraft," by Lieut. Cdr. D. J. Whitehead (Blackburn and General Aircraft), in the library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

February 25.—R.Ae.S. Bristol Branch lecture, "Future Safety Requirements in Air Transport," by W. Tye (A.R.B.) and R. B. Meyersburg (C.A.A.), at Filton House, **Bristol,** at 18.00 hrs.

February 25.—R.Ae.S. Christchurch Branch lecture, "Navigation Aids," by G. E. Beck, at the King's Arms Hotel, **Christchurch,** at 19.30 hrs.

February 25.—R.Ae.S. Hatfield Branch lecture, "Development of the P.1. Aircraft," by F. W. Page (English Electric), at the de Havilland Restaurant, **Hatfield,** at 18.15 hrs.

February 25.—R.Ae.S. Preston Branch lecture, "Operational Problems in Supersonic Flight Testing," by R. P. Beamont (English Electric), at the R.A.F.A. Hall, **Preston,** at 19.30 hrs.

February 26.—R.Ae.S. Southend Branch lecture, "Aircraft Electrical Installations," by G. G. Wakefield (Rotax), at the Labour Hall, Boston Ave., **Southend,** at 19.30 hrs.

February 26.—R.Ae.S. Belfast Branch lecture, "Noise and its Effects on Aircraft Structures," by M. O. W. Wolfe, in lecture hall L98, David Keir Building, Queen's University, **Belfast,** at 19.00 hrs.

March 3.—R.Ae.S. Luton Branch lecture, "Missile Reliability," by E. H. Ingamells, in the Napier senior staff canteen, **Luton Airport,** at 18.15 hrs.

March 4.—R.Ae.S. Brough Branch lecture, "Aircraft Carriers," by J. C. Lawrence (Admiralty), in the lecture hall, Electricity Offices, Ferensway, **Hull,** at 19.30 hrs.

March 4.—R.Ae.S. Graduates and Students Section, A.G.M. and film show, in the library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

March 5.—R.Ae.S. Gloucester and Cheltenham Branch lecture, "Experiences of an Airline Pilot," by Capt. O. P. Jones (B.O.A.C.), at St. Mary's College, St. George's Place, **Cheltenham,** at 19.30 hrs.

March 5.—R.Ae.S. Main lecture at London Airport Branch, First Sir Richard Fairey Memorial Lecture, by G. W. Hall (Fairey Aviation), at the Feltham Hotel, **Feltham,** at 18.00 hrs., followed by L.A.P. Branch annual dinner at 20.00 hrs.

March 6.—Helic. Assn. of G. B., lecture, "The Place of the Helicopter in a Modern Army," by Lt.-Col. P. W. Mead (War Office), in the R.Ae.S. library, 4 Hamilton Place, **London,** W.1, at 18.00 hrs.

Birth Notices

Busby.—On January 26, at Pembroke, to Mollie (*née* Pinnock), wife of Flt. Lt. V. H. E. Busby—a daughter.

Calder.—On February 2, in Cardiff, to Beryl (*née* Carpenter), wife of Flt. Lt. I. M. Calder—a son.

Cawthorn.—On February 4, at Reading to Joyce (*née* Parnell), wife of Flt. Lt. P. F. Cawthorn—a daughter.

Davies.—On February 4, at B.M.H. Hong Kong, to Daphne (*née* Barnes), wife of Flt. Lt. Alvan Davies—a son.

Hitchcock.—On February 4, at R.A.F. Hospital, Ely, to Patricia (*née* Penney), wife of Flt. Lt. J. E. Hitchcock—a son.

McRae.—On February 3, at Carshalton, to Valerie (*née* Chadwick), wife of Sqn. Ldr. H. J. McRae—a daughter.

Ryan.—On February 3, at the Norfolk and Norwich Hospital, to Tamaris (*née* Adams), wife of Flt. Lt. K. J. Ryan—a son.

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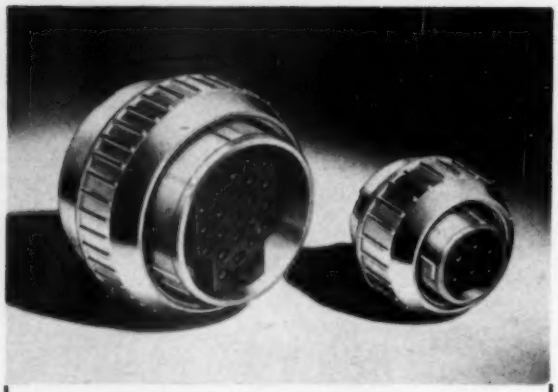

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These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 477-8

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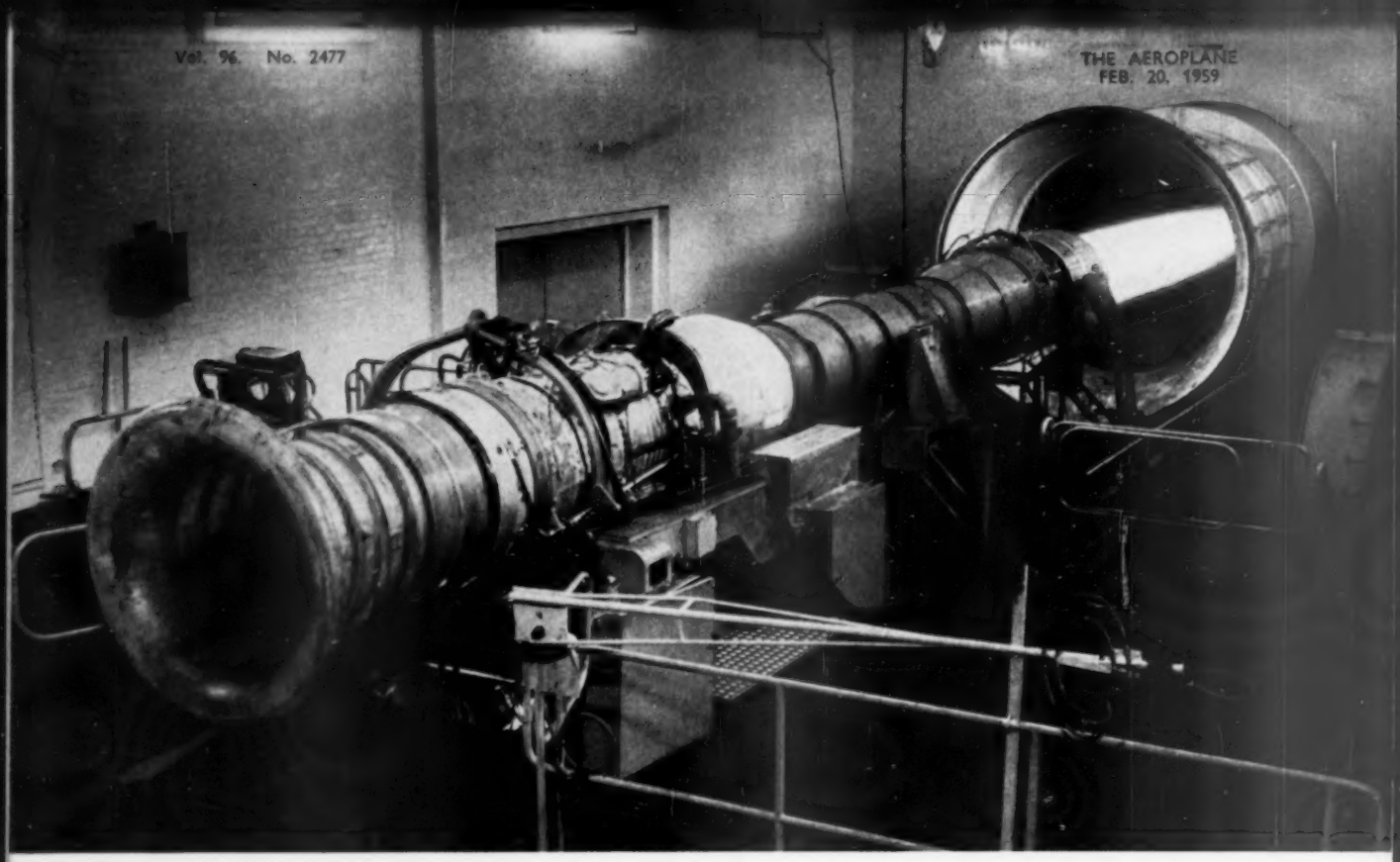

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